UPSC CURRENT AFFAIRS

28-08-2023

PARTICIPATION OF INDIAN AIR FORCE IN EXERCISE BRIGHT STAR-23 AT CAIRO AIR BASE, EGYPT

An Indian Air Force (IAF) contingent departed today, for participating in Exercise BRIGHT STAR-23 a biennial multilateral tri-service exercise scheduled to be held at Cairo (West) Air Base, Egypt from 27 August to 16 September 2023.

This is for the first time that IAF is participating in Ex BRIGHT STAR-23 which will also see participation of contingents from the United States of America, Saudi Arabia, Greece and Qatar. The Indian Air Force contingent will consist of five MiG-29, two IL-78, two C-130 and two C-17 aircraft. Personnel from the IAF's Garud Special Forces, as well as those from the Numbers 28, 77, 78 and 81 Squadrons will be participating in the exercise. The IAF transport aircraft will also provide airlift to approximately 150 personnel from the Indian Army.

The objective of the exercise is to practice planning and execution of joint operations. Besides leading to the formation of bonding across borders, such interactions also provide a means to further strategic relations between participating nations. IAF contingents to flying exercises abroad are thus no less than Diplomats in Flight Suits.

India and Egypt have had exceptional relationship and deep cooperation wherein the two jointly undertook development of aero-engine and aircraft in 1960s and training of Egyptian pilots was done by Indian counterparts. The relationship between the two civilizational countries was further strengthened with the recent visits by Chief of Air Forces of the two countries and Indian Defence Minister and Prime Minister to Egypt. The two countries have also enhanced their joint training with regular exercises between their Armed Forces.

Chandrayaan-3 mission is expected to send home information about Moon's atmosphere, soil, minerals etc which may be the first of its kind for the scientific community across the world and of far-reaching implications in the times to come.

"Vikram Lander and Pragyan Rover have started performing the Mission objectives exactly as per the schedule".

ISRO to launch an awareness campaign across the country next month, mobilizing students and the common man in view of the huge interest witnessed in the Live telecast of Chandrayaan-3 Moon Landing, says Dr Jitendra Singh

"Our ability to reach out to space is now proven beyond doubt as the Prime Minister himself said Space is no limit": Dr Jitendra Singh

Chandrayaan-3 mission is expected to send home information about Moon's atmosphere, soil, minerals etc which may be the first of its kind for the scientific community across the world and of far-reaching implications in the times to come, said Union Minister of State for Space, Dr. Jitendra Singh today, adding that the Vikram Lander and Pragyan Rover have started performing the Mission objectives exactly as per the schedule.

In an exclusive interview to a media agency, Dr Jitendra Singh said, the main focus of the science payloads onboard Chandrayaan-3 is to provide an integrated assessment of the lunar surface features, including the thermal properties and surface elements of the lunar topsoil (regolith) as well as the plasma environment near the surface, he said. It will also assess the lunar seismic activities and the impact of meteors on the lunar surface.

"All these are essential for the fundamental understanding of the lunar near-surface environment and for making future lunar habitat developments for explorations," said Dr Jitendra Singh, who is also the Union Minister of State (Independent Charge) Science & Technology; MoS PMO, Personnel, Public Grievances, Pensions, and Atomic Energy.

Vikram Lander carries seismometer (ILSA), ChaSTE, Langmuir Probe (RAMBHA-LP), and a laser retroreflector array payloads and the Pragyan Rover carries Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscope (LIBS) payloads.

"All these payloads are planned for continuous operations from 24th August 2023 till end of the mission," said Dr Jitendra Singh.

The Instrument for Lunar Seismic Activity (ILSA) will make continuous observations of the lunar seismic activities as well as the meteors impacting the lunar surface. ILSA is the first-ever seismometer sent to study the vibrations on the lunar surface at higher lunar latitudes.

"These measurements will help us plan for future habitat developments by understanding the frequency of potential hazards from meteor impacts and seismic activities," said Dr Jitendra Singh.

The ChaSTE (Chandra's Surface Thermo-physical Experiment) is another key instrument mounted on the Vikram Lander, said Dr Jitendra Singh. Ten high-precision Thermal Sensors, mounted on ChaSTE, will dig into the moon's top soil to study temperature variations. ChaSTE is the first-ever experiment to study the thermophysical properties of the first 10 cm of the lunar surface.

Surface of the moon undergoes substantial temperature variations during the lunar day and night, with minimum temperatures of <-100 ℃ around the local midnight, and >100℃ around the local noon. The porous lunar topsoil (having a thickness of about ~5-20 m) is expected to be an excellent insulator. Because of this insulating property and absence of air, very significant temperature difference is expected between the top surface and interior of the regolith.

"The low density and high thermal insulation of the regolith enhances its potential as a basic building block for future habitats while the assessment of the wide range of temperature variations are crucial for survivability," said Dr Jitendra Singh.

The study of the near-surface plasma of the Moon and its time variations will be carried out by the Langmuir probe. RAMBHA-LP will be the first-ever in-situ observation of the near-surface plasma and its diurnal variation in higher lunar latitude, where the Sun elevation angle is less, said Dr Jitendra Singh.

"These will help assess the lunar surface charging for future manned missions," he said.

The Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscopy (LIBS), mounted on the Pragyan, will make the measurements of lunar surface elements at the stop-points (once in about 4.5 hours) along the Rover track. These are first-ever in situ study of lunar surface elemental composition in the higher latitudes, said Dr Jitendra Singh.

"These measurements can make inference on the potential surface elemental compositions which will be helpful for future self-sustaining habitat developments," he said.

Besides probe instruments mounted on the Lander & Rover, the Chandrayaan-3 Mission carries the Spectropolarimetry of Habitable Planet Earth (SHAPE) onboard the Propulsion orbit of the moon.

"It will help identify earth-like exoplanets in future," said Dr Jitendra Singh, adding, "The data will be made available to the students and general public after the initial analysis and consolidations.

Though the mission life of Lander and Rover is designed to last one Moon Day, equivalent to 14 Earth days, after which Vikram and Pragyan will go in hibernation, said Dr Jitendra Singh, and after one Moon Night, or 14 Earth Days, ISRO scientists will try their luck if the two would have survived the extremely cold night temperatures and can be revived by residual battery and switching on their solar panels.

Meanwhile, ISRO is gearing up for the launch of Aditya-L1 mission by the first week of September, using the Polar Satellite Launch Vehicle (PSLV) XL with 7 payloads (instruments) onboard. Aditya L1 would be the first space-based Indian mission to study the Sun. The spacecraft shall be placed in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about 1.5 million km from the Earth. A satellite placed in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without any occultation/eclipses.

Dr Jitendra Singh said the Gaganyaan, India's first manned mission to space, will be the next major project before ISRO.

"We will have at least two missions before we send a human being. We will have the first mission possibly in September or early next year, where for a few hours we will send an empty spacecraft that will go up and come back into the waters to see if we are able to control its safe return without any damage. If that is successful, then we will have a second trial next year by sending a robot called Vyom Mitra. And if that is also successful, we will send the final mission, which will be the human mission. This could possibly take place in the second half of 2024. Initially we had planned it for 2022, but it got delayed due to Covid," he said.

Dr Jitendra Singh said that in the past nine years after the Prime Minister Shri Narendra Modi assumed office, been given the freedom to apply space technology to areas of infrastructure development.

"Till the year 2013, 40 launch vehicle missions were accomplished with nearly 3 launches on an average per year. This has doubled in the last 9 years with 53 launch vehicle missions at an average of 6 launches per year," he said, adding, "ISRO had launched 35 foreign satellites till 2013. This has seen exponential growth in the last 9 years with nearly 400 foreign satellites launched."

Dr Jitendra Singh said India has established its own regional navigation satellites system serving the strategic and civilian requirements in the last 9 years. PM Modi initiated Space sector reforms, making Space easily accessible for Indian private players and a comprehensive Indian Space Policy 2023 was released covering all stakeholders.

Dr Jitendra Singh said the country started witnessing the emergence of Space sector Startups only after 2014 with nearly 200 startups at present, working across various space domains. The

first Indian private sub-orbital launch was witnessed recently which was enabled through the Space sectoral reforms.

“Our ability to reach out to space is now proven beyond doubt as the Prime Minister himself said Space is no limit. So we have gone beyond space to discover the unexplored areas of the universe,” he said.

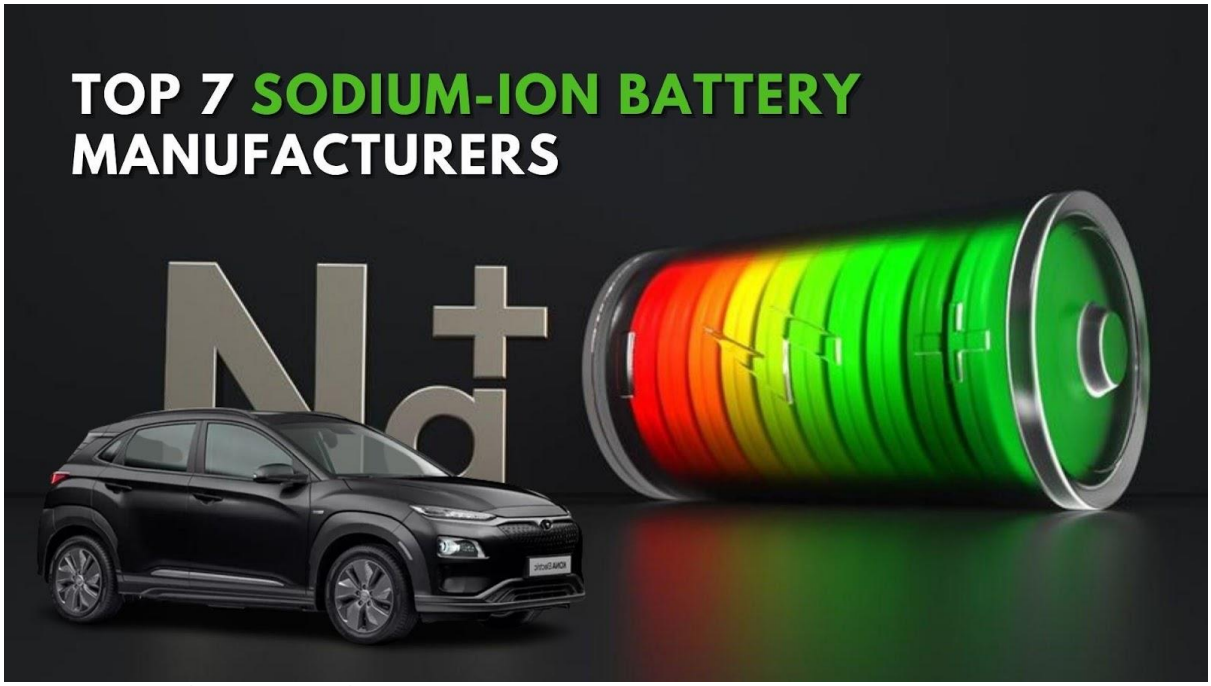
Dr Jitendra Singh said the ISRO will launch an awareness campaign across the country next month, mobilizing students and the common man in view of the huge interest witnessed in the Live telecast of Chandrayaan-3 Moon Landing.

With over 8 million concurrent viewers, the touchdown of Chandrayaan-3's lander module became the most-watched event on YouTube during live streaming. It even left behind the concurrent viewership of the football match between Brazil and South Korea during the World Cup 2022 quarterfinals, which had garnered 6.1 million views. Around 70 million viewers watched the Chandrayaan-3 landing later. However, the actual number of viewers could be higher due to numerous group screenings.

The awareness campaign will kick off on 1st September and will include online and offline activities including Flashmobs, Mega Town Halls, Quiz contests and Best Selfies, with a focus on Space Startups and Tech Partner Companies.

SODIUM ION BATTERY

Coimbatore-based start-up AR4 Tech has announced a strategic partnership with Singapore's Sodion Energy to produce sodium ion battery packs for both the domestic and export markets.



The collaboration aims to leverage Sodion Energy's expertise in sodium-ion battery technology and AR4 Tech's manufacturing capabilities.

Factory Setup and Production Plans

AR4 Tech is in the process of establishing a new factory spanning 15,000 square feet in Coimbatore.

The factory is expected to be operational within the next four months and will focus on the production of battery packs using the sodium-ion batteries developed by Sodion Energy.

The facility will be equipped with semi-automatic production lines featuring imported equipment, enabling the production of approximately 100 battery packs per day.

Conversion of Petroleum Vehicles into Electric Vehicles

AR4 Tech plans to utilize the manufactured battery packs to retrofit existing petroleum-based vehicles, particularly two-wheelers, into electric vehicles.

The sodium-ion battery packs, known for their potential long-life cycle of nearly 10 years, will provide a sustainable energy source for these converted EVs.

Additionally, the battery packs will have applications in uninterrupted power supply (UPS) systems, further expanding their potential use cases.

Challenges and Regulatory Environment

India currently lacks established quality and safety standards for sodium-ion battery packs.

This emerging sector requires the establishment of a favorable regulatory environment to ensure the safe and efficient adoption of this technology.

While sodium-ion batteries offer benefits such as resource abundance and potentially enhanced safety, addressing regulatory considerations is essential to unlock their full potential.

Introduction to Sodium Ion Batteries

Battery technologies have undergone significant evolution over the years, from traditional lead-acid batteries to the widely used lithium-ion batteries. This evolution is driven by the increasing demand for energy storage solutions to support various applications such as portable electronics, electric vehicles, and renewable energy integration.

Role of Energy Storage Technologies

Energy storage systems play a crucial role in stabilizing power grids, enabling intermittent renewable energy sources, and providing portable power. As renewable energy sources like solar and wind become more prevalent, the need for efficient and scalable energy storage technologies becomes paramount.

Need for Sodium Ion Batteries

While lithium-ion batteries dominate the energy storage landscape, concerns over the limited availability of lithium resources and its geopolitical implications have prompted the

exploration of alternative battery chemistries. Sodium, being abundant and widely available, offers a viable alternative to lithium for large-scale energy storage applications. Sodium ion batteries have the potential to bridge the gap between the demand for energy storage and the sustainability of resources.

Basic Principles and Components

Electrolyte: Facilitator of Ion Movement

The electrolyte serves as a medium for the transportation of sodium ions between the anode and cathode.

It must exhibit high ionic conductivity while maintaining stability.

Liquid electrolytes and solid-state electrolytes are being researched to enhance the safety and performance of sodium ion batteries.

Anode Materials: Sodium Storage Mechanisms

Anode materials play a pivotal role in sodium ion batteries, determining their capacity, cycle life, and safety.

Materials like hard carbon, soft carbon, and various transition metal compounds are used as anodes.

Sodium ions are inserted into the anode material during charging and extracted during discharging through intercalation or conversion reactions.

Cathode Materials: Reversible Sodium Intercalation

Cathode materials must enable reversible sodium intercalation to store and release energy efficiently.

Materials like Prussian blue analogs, polyanionic compounds, and transition metal chalcogenides exhibit suitable properties for accommodating sodium ions in their crystal structure, allowing for reversible electrochemical reactions.

Working Principle: Charge and Discharge Processes

During charging, sodium ions move from the cathode to the anode through the electrolyte.

This migration is reversed during discharging.

The movement of ions leads to the flow of electrons through an external circuit, generating electrical energy that can be utilized for various applications.

Comparison with Other Battery Technologies

Sodium Ion vs. Lithium-ion Batteries

Resource Abundance and Cost Factors

Sodium is significantly more abundant than lithium in the Earth's crust, reducing concerns about resource scarcity.

This abundance translates into potentially lower production costs, making sodium ion batteries an attractive option for large-scale applications.

Energy Density and Power Density Comparison

Lithium-ion batteries generally offer higher energy density than sodium ion batteries.

However, sodium ion batteries can still provide sufficient energy density for applications such as grid-scale energy storage, where size and weight constraints are less critical.

Safety Considerations

Sodium ion batteries have the potential to be safer than lithium-ion batteries due to the larger size of sodium ions, which reduces the risk of dendrite formation and thermal runaway.

Additionally, the use of solid electrolytes can enhance safety by eliminating flammable liquid electrolytes.

Pros and Cons of Sodium Ion Batteries

Pros

Abundance of sodium resources

Potential for lower production costs

Safer electrolytes and reduced thermal risks

Suitable for grid-scale energy storage

Cons

Lower energy density compared to lithium-ion batteries

Limited commercial availability and development compared to lithium-ion technology

Anode Materials

Carbon-based Materials

Hard Carbon

Hard carbon materials, derived from sources like graphite and biomass, offer good cycling stability and reversible sodium intercalation. However, they may suffer from lower initial capacity compared to other materials.

Soft Carbon

Soft carbon materials, often obtained from petroleum residues, provide higher initial capacity but might experience capacity fading over cycling due to structural changes.

Transition Metal Oxides

Transition metal oxides, such as tin-based compounds, offer high theoretical capacity for sodium storage. However, they can experience significant volume changes during cycling, leading to electrode degradation.

Phosphates and Silicates

Phosphate and silicate-based materials provide good cycling stability and reversible reactions,

making them potential candidates for long-lasting sodium ion batteries.

Cathode Materials

Prussian Blue Analogs

Prussian blue analogs, such as iron hexacyanoferrates, are promising cathode materials for sodium ion batteries. They offer a reversible sodium insertion/extraction mechanism, high capacity, and good cycling stability. Their open framework structure allows for the accommodation of sodium ions during charging and discharging.

Polyanionic Compounds

Polyanionic cathode materials, like sodium iron phosphates, exhibit stable cycling performance due to their robust crystal structures. They enable reversible sodium intercalation while maintaining structural integrity, making them suitable for long-term battery operation.

Transition Metal Chalcogenides

Transition metal chalcogenides, including sulfides and selenides, provide high theoretical capacities and favorable electronic conductivity. However, their large volume changes during cycling can lead to mechanical stress and performance degradation over time.

Electrolytes and Ionic Conductors

Liquid Electrolytes

Liquid electrolytes, typically composed of sodium salts dissolved in organic solvents, facilitate ion transport between the anode and cathode. While they offer high ionic conductivity, they also pose safety risks due to flammability and potential leakage.

Solid Electrolytes

Solid electrolytes offer improved safety and stability compared to liquid counterparts. They can suppress dendrite formation and eliminate the risk of electrolyte leakage. However, challenges remain in achieving high ionic conductivity and interface compatibility with electrode materials.

Importance of Ion Mobility

Ionic conductivity is crucial for efficient charge/discharge processes. Enhancing ion mobility in both the electrolyte and electrode materials is essential to achieve high-performance sodium ion batteries.

Cell Chemistry and Reactions

Sodium Insertion/Extraction Mechanisms

Sodium ion batteries involve reversible insertion/extraction of sodium ions into/from the electrode materials during charging and discharging. Understanding the mechanisms of these electrochemical reactions is key to optimizing battery performance and cycle life.

Intercalation vs. Conversion Reactions

Different materials exhibit varying reaction mechanisms. Some materials undergo intercalation reactions, where sodium ions fit into the crystal lattice of the electrode material. Others undergo conversion reactions, where chemical transformations occur between the electrode and sodium ions.

Battery Performance and Metrics

Energy Density and Specific Energy

Energy density refers to the amount of energy stored per unit volume or mass of the battery. While sodium ion batteries generally have lower energy density than lithium-ion batteries, they can still offer sufficient energy density for certain applications.

Power Density and Specific Power

Power density measures how quickly a battery can deliver energy. Sodium ion batteries can provide competitive power density, enabling rapid energy delivery for applications requiring high power outputs.

Cycle Life and Calendar Life

Cycle life refers to the number of charge/discharges cycles a battery can undergo while maintaining a specified capacity. Calendar life refers to the battery's operational lifespan even when not in use. Optimizing both aspects is crucial for the economic viability of sodium ion batteries.

Challenges and Solutions

Crystallographic Changes in Electrode Materials

Some electrode materials undergo structural changes during sodium ion insertion/extraction, leading to capacity fading and reduced performance. Designing materials with stable crystal structures and accommodating volume changes is a research focus.

Sodium Dendrite Formation

Like lithium-ion batteries, sodium ion batteries can suffer from dendrite growth, which can short-circuit the battery and lead to safety hazards. Strategies such as electrolyte additives and solid electrolytes are being explored to mitigate this issue.

High Operating Temperature

Some sodium ion batteries may require elevated temperatures to achieve desirable performance. Developing materials and designs that operate efficiently at ambient temperatures is crucial for practical applications.

Capacity Fading Over Cycles

Repeated cycling can lead to capacity degradation due to electrode material fatigue and electrolyte breakdown. Improving electrode stability and electrolyte design are essential for maintaining consistent performance over the battery's lifespan.

Applications and Market Potential

Grid-Scale Energy Storage

Sodium ion batteries hold potential for large-scale energy storage, helping to stabilize power grids by storing excess energy during low-demand periods and releasing it during peak demand. Their scalability and potentially lower cost make them an attractive option for grid operators.

Renewable Energy Integration

Sodium ion batteries can facilitate the integration of intermittent renewable energy sources, such as solar and wind, by storing surplus energy and delivering it when energy generation is low. This enhances grid stability and reduces reliance on fossil fuels.

Electric Vehicles and Portable Electronics

While their energy density might be lower than lithium-ion batteries, sodium ion batteries can still find applications in electric vehicles (EVs) and portable electronics. They offer a more sustainable alternative to lithium-ion technology and can help reduce the environmental impact of battery production.

Research and Development Trends

Advancements in Electrode Materials

Ongoing research focuses on discovering new electrode materials with improved capacity, stability, and safety. Nanomaterials, composites, and hybrid structures are being explored to enhance performance.

Exploration of New Electrolytes

The development of solid-state electrolytes with high ionic conductivity is a major research direction. These electrolytes can offer enhanced safety, wider operating temperature ranges, and compatibility with various electrode materials.

Emerging Technologies and Innovations

Nanotechnology, 3D printing, and advanced manufacturing techniques are being employed to optimize battery design and enhance performance. Innovations in battery management systems and predictive modeling are also contributing to the advancement of sodium ion battery technology.

Environmental and Safety Considerations

Sodium Abundance and Sustainability

The abundance of sodium in Earth's crust makes sodium ion batteries a potentially sustainable energy storage solution. This contrasts with lithium-ion batteries, which rely on limited lithium resources.

Toxicity and Environmental Impact

Sodium ion batteries generally have lower toxicity concerns compared to lithium-ion batteries. However, environmental considerations regarding the extraction of raw materials, manufacturing processes, and end-of-life disposal remain important.

Safety Measures and Thermal Stability

Solid electrolytes and improved electrode materials can enhance the safety of sodium ion batteries by reducing the risk of dendrite formation, thermal runaway, and electrolyte leakage.

Commercialization and Industry Players

Companies Developing Sodium Ion Battery Technology

Several companies are actively engaged in the research, development, and commercialization of sodium ion battery technology. Collaborations between startups, established battery manufacturers, and research institutions are driving innovation in this field.

Current Market Status and Future Projections

While sodium ion batteries are still in the early stages of commercialization compared to lithium-ion batteries, the market is expected to grow as technology advancements continue. As the demand for large-scale energy storage and sustainable energy solutions increases, sodium ion batteries are poised to play a significant role.

Regulations and Standards

Battery Safety Standards

As sodium ion battery technology progresses, safety standards are being established to ensure the safe manufacturing, transportation, and usage of these batteries. These standards help mitigate risks and ensure consistency in quality and safety.

Regulatory Frameworks for Sodium Ion Batteries

Regulatory bodies and governments are gradually developing frameworks to govern the production, use, and disposal of sodium ion batteries. These frameworks aim to address environmental concerns, ensure safety, and promote responsible battery development

The ISRO-Space Applications Centre (Ahmedabad) successfully tested the Nabhmitra device at Neendakara.

It is a satellite-based communication system developed for the safety of fishermen.

It enables two-way messaging services from and to the sea.

The weather and cyclone warnings will be communicated in the local language, the boats can also send distress messages to the authorities.

In emergency situations like capsizing and fire, fishers can press a button on the device and get in touch with the control centre.

While the control centre will receive the alert, including the location of the boat, the crew on the boat will get a response message from the control centre.

Apart from providing information about shipping channels and maritime boundaries, the device will also help to identify fishing fields.

It was developed by the Indian Space Research Organisation (ISRO).

Chokuwa rice

- It is also known as Magic rice cultivated in Assam.
- It is a part of Assam's culinary heritage; this unique rice has been a staple of the troops of the mighty Ahom dynasty.
- This unique and healthy rice is cultivated around the Brahmaputra River area.(In several parts of Assam like Tinsukia, Dhemaji, Dibrugarh, etc.)
- It is basically semi-glutinous winter rice, known as Sali rice.
- The sticky and glutinous variety is categorised as Bora and Chokuwa based on their amylose concentration.
- The low amylase Chokuwa rice variants are used to make soft rice, which is known as Komal Chaul or soft rice.
- This whole grain can be consumed after soaking the rice in cold or lukewarm water. This rice variety is widely consumed for its convenience of preparation and nutritional value.

- This unique rice variety is consumed with curd, sugar, jaggery, and bananas to name a few.
- This rice is also used in making several Assamese delights like Pithe and other local dishes.

Clethodim

About the study and findings

It was a collaborative study of researchers from Kasturba Medical College (KMC), Manipal Academy of Higher Education (MAHE), Manipal, and Yenepoya Research Center, Mangaluru.

The findings were published in the journal Chemosphere.

The research has unveiled alarming insights into the potential impact of the widely used herbicide clethodim on male reproductive health.

The study reveals a spectrum of effects including a reduction in testicular weight, a decrease in germ cell population, lower levels of serum testosterone, abnormalities in sperm, and compromised preimplantation embryo development.

Importance of the findings

These findings necessitate further investigation and reconsideration of the use of such herbicides to ensure the well-being of both humans and our environment.

There is a necessity for molecular-level screenings to comprehend the potential effects of herbicides on human and environmental health.

The researchers underlie the urgency of comprehensive testing for this post-emergent herbicide.

There is a need for revisiting the application of the herbicid

Advocacy for upgraded standards in the formulation of new agents for similar uses can be done.

About Clethodim

It is an organic compound.

It is a member of the cyclohexanedione family of herbicides.

It is used to control grasses, especially Lolium rigidum.

Clethodim has been an approved herbicide in India and globally for some time.