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From the Editor's

Dear Readers,

In the April issue of our Newsletter, we received several popular articles from diverse fields. All the authors deserve great appreciation for sharing articles in huge numbers. Please continue sending articles to our Publication team and share published newsletter with your friends also.

I would like to thank the Editorial team including Print, Designer and Publication committee for their efforts throughout the edition.

Your suggestions are always welcomed for improvement.

**Dr. R. S. Tomar**
Editor-in-Chief



## CONVENTIONAL AND ALTERNATIVE ENERGY RESOURCES

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Conventional and alternative energy sources refer to two broad categories of energy used for electricity, heating, transportation, and other needs.

**1. Conventional Energy Sources**
These are traditional energy sources that have been used for decades and are usually non-renewable. They include:

**Coal**

**Oil**

**Natural gas**

**Nuclear power**

**Usage Around the World:**
Still dominate global energy supply (especially in industrialized and developing nations).

**Used in power plants, vehicles, and industries.**

Countries like China, the U.S., and India rely heavily on coal and natural gas for electricity.

**2. Alternative Energy Sources**
These are newer or more sustainable options, often renewable. They include:

**Solar power**

**Wind energy**

**Hydropower**

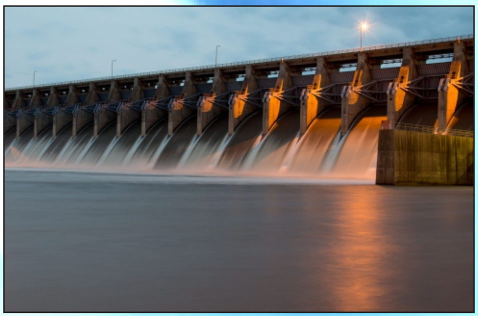
**Geothermal energy**

**Biomass**

**Tidal and wave energy**

**Usage Around the World:**
Rapidly growing due to climate concerns and advancing technology.

Countries like Germany, Denmark, and Iceland are leading in wind, solar, and geothermal.


Many nations are shifting to a mix of renewables to reduce carbon emissions.

**Key Difference:**
Conventional sources are mostly non-renewable and polluting.

Alternative sources aim to be sustainable and environmentally friendly.

Comparison of the merits and demerits of conventional and alternative energy sources:

Conventional Energy Sources
(e.g., coal, oil, natural gas, nuclear)

**Merits:**
**High Energy Output:** Capable of producing large amounts of energy efficiently.

**Established Infrastructure:** Existing global infrastructure supports extraction, transportation, and use.

Reliable Supply: Can provide continuous, base-load power (24/7 availability).

**Technologically Mature:** Decades of development and optimization.

**Demerits:**
**Environmental Damage:** Major contributor to air pollution, greenhouse gases, and global warming.

**Finite Resources:** Non-renewable; reserves will deplete over time.

**Health Hazards:** Emissions can cause respiratory and other health issues.

**Waste Disposal Issues:** Especially for nuclear energy (e.g., radioactive waste).
Alternative (Renewable) Energy Sources
(e.g., solar, wind, hydro, geothermal, biomass)

**Merits:**
**Eco-Friendly:** Low or zero emissions; minimal impact on climate change.

**Sustainable:** Replenished naturally; virtually inexhaustible.

**Low Operating Costs:** After setup, maintenance and running costs are often low.

**Energy Independence:** Reduces reliance on imported fuels.

**Demerits:**
Intermittency: Some sources (e.g., solar, wind) depend on weather conditions.

**High Initial Costs:** Installation and infrastructure can be expensive.

**Land Use and Habitat Disruption:** Some projects can disturb ecosystems (e.g., large hydro or wind farms).

**Storage Issues:** Requires efficient energy storage solutions to manage supply-demand mismatch.

Challenges of the successful ground implementation of alternative energy usage around the globe

The successful ground implementation of alternative energy around the globe faces a range of technical, economic, political, social, and environmental challenges. Here's a breakdown of the major ones:

**1. High Initial Costs**
Infrastructure investment: Solar farms, wind turbines, grid upgrades, and battery storage require large upfront capital.

Technology costs: While prices have decreased, advanced tech like green hydrogen or tidal energy is still expensive.

**2. Intermittency and Reliability**
Weather dependence: Solar and wind power fluctuate with sunlight and wind availability.

Storage limitations: Current battery tech can't always store enough energy for long periods or large-scale needs.

**3. Grid Integration Issues**
**Outdated grids:** Many existing power grids aren't designed to handle decentralized or variable energy sources.

**Grid upgrades needed:** Smart grids and better transmission infrastructure are necessary but costly and time-consuming.

**4. Lack of Political Will and Policy Support**
Subsidies for fossil fuels: Many countries still support oil, coal, and gas industries.

**Regulatory hurdles:** Permitting, bureaucracy, and unclear regulations can delay or block projects.

**5. Economic and Market Barriers**
Energy market structure: In many places, monopolies or

entrenched interests control the energy supply chain.

Return on investment uncertainty: Investors may be wary due to fluctuating policies or long ROI periods.

**6. Public Resistance and Awareness**
NIMBY attitudes: Local opposition to wind farms, solar installations, or grid expansions.

**Lack of education:** Misinformation or limited understanding of renewable energy's benefits.

**7. Resource and Geographical Limitations**
**Uneven distribution:** Sunlight, wind, and other renewables aren't equally available everywhere.

**Land use competition:** Solar and wind farms can compete with agriculture, housing, or conservation needs.

**8. Supply Chain and Material Constraints**
**Rare earth elements:** Many renewable technologies require materials that are limited or concentrated in specific regions.

**Manufacturing capacity:** Limited in some countries, causing dependence on imports.

**9. Environmental and Ecological Concerns**
**Impact on wildlife:** Wind turbines can affect birds and bats; hydropower alters aquatic ecosystems.

**Land and water use:** Some renewable projects may require significant resources.

**10. Global Inequity**
**Developing countries:** Often lack access to financing, technology, and expertise for large-scale renewables.

**Energy poverty:** In many areas, the focus is still on gaining basic energy access, regardless of source.

Alternative Energy resources being regarded as the choice of the future and for our sustainable growth

Alternative energy resources—like solar, wind, hydro, geothermal, and biomass—are increasingly being regarded as the choice of the future and key to sustainable growth for several important reasons:

Environmental Protection: Unlike fossil fuels, alternative energy sources produce little to no greenhouse gas emissions, helping to combat climate change and reduce air and water pollution.

Sustainability: These energy sources are renewable, meaning they won't run out. The sun, wind, and water cycles are naturally replenished, making them a sustainable long-term solution.

Energy Security: Relying on local renewable resources reduces dependence on imported fuels, enhancing national energy security and reducing vulnerability to global energy market fluctuations.

Economic Growth and Jobs: The renewable energy sector is creating millions of new jobs in manufacturing, installation, maintenance, and innovation, contributing to economic development.

Technological Advancement: Rapid improvements in energy storage, smart grids, and energy efficiency technologies are making alternative energy more reliable and cost-effective.

Public Health Benefits: Cleaner energy sources mean less pollution, leading to fewer health problems like asthma, heart disease, and cancer caused by burning fossil fuels.

In short, alternative energy is crucial for a healthier planet, a stable economy, and a sustainable future.

## WORKSHOP ON ON GEOPOLITICS & CLIMATE CHANGE

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An online workshop on GEOPOLITICS & CLIMATE CHANGE was conducted by myself under Indian Science News Association (ISNA) on February 20, 2025 attended by over a dozen participants. The geopolitics of Climate Change is a complex and evolving field that examines how global warming influences international relations, security, and economic power dynamics. Some of the key aspects highlighted upon included global power shifts, resource competition and conflicts, climate migration and security risks, Green Energy geopolitics, Climate Diplomacy and cooperation, military adaptation and Security Strategies, impact on biodiversity, economic and political interest convergence and biodiversity conservation. An engaging discussion was followed with participants making significant important points related to Geopolitics of Climate Change; as discussed below.

One of the workshop attendants, Mr. Kingshuk Roy highlighted that economic power is one of the driving forces of geopolitics and energy (mostly hydro-carbon based) that propels the economy of a nation. So we say that geopolitics is directly proportional to the energy resources and its supply chain. But, now the world is facing one of the most volatile geopolitical periods due to ongoing conflicts, extreme weather condition, trade disputes, sanctions, and hydrocarbon resource competition. He added that international relations have always been marked by a degree of rivalry, tension and often conflict between states. Climate change is one of the most pressing issues of current day geo-political scenario. The average global temperature is expected to rise by 3-5°C by 2100, which could have devastating consequences for our World. The leading cause of climate change is the emission of green house gases, such as $CO_2$ emission. The main reason for increase in $CO_2$ emission is the consumption in fossil fuels. Therefore in order to make our planet cleaner, healthy our primary goal should be to reduce $CO_2$ emission.

Mr Roy further stressed that aced with the severe climate change situation the major economics of the world have gradually developed decarbonisation strategies and rules. But higher geopolitical risk due to conflict and political instability can increase $CO_2$ emission. As we have observed from the Russia-Ukraine War geo-political risk escalates $CO_2$ emission. Military spending often involves more fossil fuels, disrupt energy infrastructure, including renewable. It also hurt capital investment and more energy efficient production may be more costly. Solving global climate change is considered as an exercise of international cooperation and collective efforts of different states. "Great power rivalry generally complicates international responses to climate change. It also presents limited opportunities to enhance climate action", he suggested. As for example, in August 2022, Beijing unilaterally suspended formal dialogue with the U.S on climate change for more than a year in response to visit to Taiwan by a prominent American politician, an act on that China viewed as an affront to its claim to sovereignty over the island. According to Roy, this suspension of climate dialogue signalled that cooperation on climate change could not be entirely insulated from broader geopolitical tensions. He concluded, "So we can say that today's increasingly volatile and unstable geopolitical environment is one of the most powerful forces sharing the global energy transition and climate action".

Sulagno Samanta, another dedicated participant suggested that there are several geopolitical aspects affecting climate change; one such aspect being the use of plastics for packaging of goods. He mentioned, "In everyday life we consume snacks which are somehow served in plastic made

plates. Often, we buy packaged foods which are disposed of but not recycled. These plastics cause direct harm to our climate. Though we spread awareness through several campaigns, the government is least bothered to undertake measures for a ban. If we peep into America, most citizens rely on packaged (pre-cooked) food; therefore, the companies producing such products use plastics for packaging. The plastic production process on the other hand yields greenhouse gas resulting in climate change. If it further gets deposited in landfills methane production results in the same. The question is what's the govt. organizations including research bodies?" Mr Samanta argued that answers can be given in a simple way which is they are finding the science as well as communicating it to the public but with their hands and feet tied. The economy of a country lies on many such businesses using plastics which have penetrated into society as a daily means of human livelihood. The solution is unknown as it's very far sighted. He suggested that, "Only a healthy collaboration with several Nations can throw some light of hope. Full eradication might seem impossible but reduction can be achieved to an extent. Even in India we viewed one #AntiPlastic song which was made featuring many Bollywood singers but the picture for taking measures is quite similar. The brand new trains also serve foods in almost plastic free containers but fail to actually Go Green! Climate crisis catalises the rivalry over river".

Nabanna Mondal, another workshop participant suggested that "One of the biggest issues of our times is the climate change all over the world or better to say a climate crisis has begun globally which makes us to rethink about the survival of the future generation. So, every country, every nation is busy to make sure their people may survive the coming crisis and here begins all the conflicts and the rivalries. Now, what is climate change? In simple language it is a long term shift in weather pattern and many factors are involved here like global warming caused by excessive pollution, industrialization, humans' way of excessive consumerism, excessive demand of animal food worldwide, human population growth etc. One of the consequences of the

climate change is the shortage of water in coming days. Climate change has disrupted traditional water cycles, leading to reduced rainfall, shrinking glaciers and drying rivers". He added that the scarcity of fresh water resources is intensifying conflicts between nations over water sharing. This issue is particularly critical in transboundary river basins, where multiple countries depend on the same water source, regions like the Middle East, South Asia and Africa.

He further elaborated that In South Asia for example; India, Pakistan and Bangladesh face conflicts over the Indus and Ganges-Brahmaputra river systems. Climate change plays an important role here. The Himalayan glaciers, which feed the Indus Basin, are predicted to diminish further in the coming years. This may increase the water flow in the short term, but it will also deplete the water level in the long run, thus reducing available water resources. At the same time, heavy rains during the monsoon are predicted to become more irregular, bringing further challenges to address potential flood risks. This will increase the tensions around issues of water distribution and flow management. The Nile River Basin, on the other hand, sees ongoing disputes between Egypt, Sudan, and Ethiopia over the Grand Ethiopian Renaissance Dam and The Mekong River Basin in Southeast Asia is another hotspot, with China, Cambodia, Vietnam, and Thailand competing for water resources. Climate change has worsened water scarcity, making it a key driver of geopolitical tensions. Mr. Mandal commented that "…..to address these challenges, nations must prioritize cooperation over conflict……Regional agreements, such as the Indus Waters Treaty between India and Pakistan, have shown promise but need stronger enforcement mechanisms".

Dr. Esha Pandit clearly stated in her speech that a few years ago the whole country was in turmoil. Patriotic Indians vowed that it is the duty of true Indians to travel to Lakshadweep instead of Maldives. Environmentalists counted all the lies. In the name of conservation, sometimes a story is written about tigers, lions, elephants in our country. But in reality, little work is done for biodiversity conservation. And in tourist spots, that hope is almost non-existent. A biodiversity hotspot like Lakshadweep may be overwhelmed by hotel resorts 10 years from now. The green, clear water around will become murky; and nd the indigenous tribes there will see, English-Hindi speaking people working in hotels built on their land, smilingly saying to foreign tourists, "Welcome to our land, Sir." Along with adventure tourism, tribal tourism is now gaining popularity in the world. Indigenous people have been living in harmony with nature for centuries in different parts of the world.

Dr. Pandit indicated that in the jungle, on isolated islands, they do not have the hunger for land and space like civilized, educated people. They do not cut down the jungle to build houses. She mentioned that they have rather made the jungle their home many centuries ago. And today, a group of eco-conscious tourists suddenly wants to enter their homes. They want to see their simple lifestyle as if they were buying tickets to watch a drama. The greed to regain the taste of the simple life that we lost many centuries ago due to the greed for money and comfort draws us to them. But do they want us? Tourism, no matter how eco-friendly it may be, is actually the cause of degradation. She said, "Among the tribals while sitting down to eat, we will want packaged mineral water that comes in plastic bottles. We will wander among them all day, and at night we will return to air-conditioned rooms. With the arrival of tourists, the use of natural resources increases". She emphasized that the tribal communities depend heavily on their natural environment for survival. This tourism can disrupt some daily habits that are compatible with environmental conservation, and climate change has compounded the

problems.

Mr. Nihar Ranjan Majumdar during her presentation, mentioned that from the current perspective of geopolitics behind water and climate change, many factors are mainly responsible for it, such as the partition of the country. He said, "We know that after the independence movement, India and Pakistan were divided, and later, when Bangladesh became independent, many people left Bangladesh and migrated to India due to religious riots. In addition, river erosion, earthquake-ravaged areas, famine-stricken areas, Bhopal gas accident, environmental pollution, waste pollution in municipal areas, accelerated mining activities, moving from one place to another for livelihood, environmental pollution due to the conversion of protected areas, forest fires, challenges of the past, and water scarcity". He stated that "In addition, extreme heat waves or weather events that are displacing millions of

# MICRO IRRIGATION SYSTEM: DRIP AND SPRINKLER IRRIGATION

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**Introduction**

Farming is the backbone of India, and water is its lifeline. But today, growing cities, factories, and more people mean less water for fields. More water required to grow food, but wells and rivers are drying up fast. Building new dams or canals is costly and harms the land, so we can't just keep adding water. Instead, we need to use what we have smarter. Micro irrigation is a modern way to do that—it saves water, grows more crops, cuts costs, and keeps your soil healthy. Unlike flooding fields, which wastes water and causes trouble like soggy or salty soil, micro irrigation puts water right where your crops need it. The Government of India is pushing it hard through schemes like *Per Drop More Crop*, aiming to water every field (*Har Khet Ko Pani*) and get more from every drop (*Per Drop, More Crop*).

Micro Irrigation

Micro irrigation is a clever way to water crops without wasting a drop. It uses pipes and small tools to give water straight to plant roots, either by dripping it slowly (drip irrigation) or spraying it like rain (sprinkler irrigation). Drip irrigation works like a slow drink for your plants, with tubes and emitters dropping water where it's needed. Sprinkler irrigation covers bigger areas, perfect for crops that need even watering. There are other types too, like micro-sprinklers, micro-jets, or gravity-fed systems. Unlike flooding, which loses water to the sun or runoff, micro irrigation saves big. The researchers say it can cut water use by 50–70% compared to old methods; while helping you grow more on the same land. It also stops waterlogging and salty soil, which can ruin fields over time. With water getting harder to find, this is a practical way to keep farming strong. Types of Micro Irrigation Systems

**Figure 1 : Drought-stressed chickpea plants – Micro-irrigation can provide life-saving water directly to the roots, preventing moisture loss**

**Figure 2: A banana plant under drip irrigation.**

**Drip Irrigation**

Drip irrigation, also called "bundi sinchai," is a system where water is delivered drop by drop to the roots of your plants through a network of pipes, tubes, and small devices called emitters. Think of it like giving your plants a slow, steady drink instead of pouring a bucket of water all at once. This method is especially useful for crops that need careful watering, like vegetables (e.g., tomatoes, potatoes, onions), fruits (e.g., mangoes, guavas), and cash crops (e.g., sugarcane, cotton).

**Sprinkler Irrigation**

Sprinkler irrigation, or "fuhar sinchai," is a system where water is sprayed over your crops like rain, using pipes and nozzles. This method is better for crops that need water spread evenly over a large area, like wheat, rice, and fodder crops, which are common in India.

**Figure 3: Sprinkler Irrigation for a lettuce crop as it require consistent moisture.**

**Importance of Micro Irrigation System**

Micro irrigation makes farming easier, cheaper, and better. Here's how it helps you:

1. **Saves Water:** It uses half the water of flooding—or less—so you can farm even when waters scarce. This is a lifesaver if your well or canal runs low.

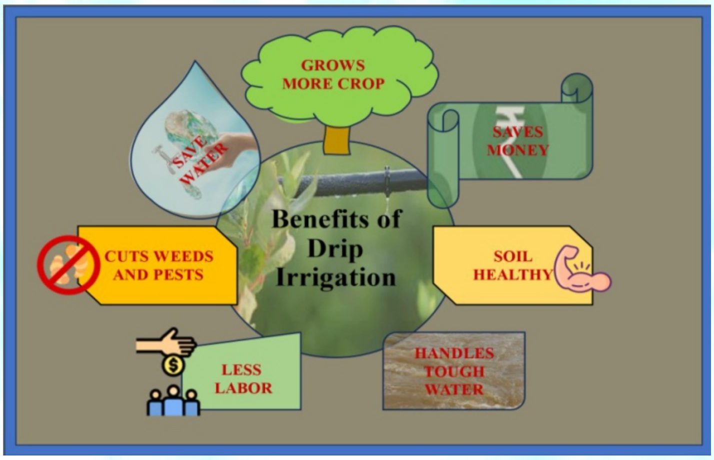


**Figure 4: Benefits of Drip Irrigation.**

1. **Grows More Crops:** Water goes right to the roots, so plants grow stronger and give more. Studies show potato farmers got 20–30% more per acre with drip irrigation. Wheat improves with sprinklers too. A government study found fruit yields jumped 42% and vegetables 53%, thanks to better water use and spacing.
2. **Saves Money:** Less water means lower pump costs—electricity use dropped 31% in tests. Mixing fertilizer in the water (fertigation) saves about 28% on fertilizer by getting it straight to roots. Irrigation costs can fall 20–50%, averaging 32%, says the National Mission on Micro Irrigation (NMMI) study.
3. **Keeps Soil Healthy:** Flooding washes away soil or makes it soggy and salty, hurting crops later. Micro irrigation avoids this, keeping your land good for years.
4. **Cuts Weeds and Pests:** Water only goes to crops, so weeds grow less, and pests and diseases don't spread as much compared to wet, flooded fields.
5. **Less Work:** Once set up, it's easier than digging channels or hauling water—saves time and labour costs, especially where workers are pricey.
6. **Handles Tough Water:** Got salty or dirty water? Micro irrigation can use it with filters, unlike flooding, which needs cleaner water.

**Challenges You Might Face**

Micro irrigation sounds great, but it's not always easy. Here's what could hold you back:

1. **High Costs:** Setting up drip or sprinklers can cost 50,000– 70,000 per acre, depending on your crops and land size. That's tough for small farmers like most in India. Subsidies help, but you still pay part.
2. **Clogs and Repairs:** Drip systems clog if water's dirty or salty—you'll need filters and regular cleaning. Sprinklers break sometimes too, adding extra work and expense.
3. **Learning It:** This isn't flooding—you need to know how to set it up and fix it. Design of Micro Irrigation Systems (DOMIS) tool can help, but you might need training from your Krishi Vigyan Kendra (KVK).
4. **Power Trouble:** It needs electricity or diesel pumps, which can be a problem if power cuts hit

your area. Solar power works but costs more to start.

5. **Not for All Crops:** Drip is perfect for veggies, fruits, sugarcane, or cotton, but not rice, which loves standing water. Sandy soils lose water fast with drip too. Sprinklers suit wheat or rice but waste water if it's windy.

6. **Water Quality:** Dirty water needs filters, or the system jams—another cost to plan for.

**"Per Drop More Crop" Scheme**

The "Per Drop More Crop" scheme is a key part of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), launched in 2015 to help farmers use water more efficiently. It provides subsidies of up to 55% for small and marginal farmers (those with less than 2 hectares of land) and 45% for other farmers to install drip and sprinkler systems. It also supports other water-saving practices, like building farm ponds, and offers training to help you learn how to use micro irrigation properly. To apply, contact your local agriculture office, Krishi Vigyan Kendra (KVK), or horticulture department, and link your Aadhaar number for direct benefit transfer (DBT).

**Micro Irrigation Fund (MIF)**

The Micro Irrigation Fund (MIF) is another important scheme, launched in 2018 by the Government of India in partnership with the National Bank for Agriculture and Rural Development (NABARD). Unlike the "Per Drop More Crop" scheme, which directly helps individual farmers with subsidies, MIF focuses on helping state governments expand micro irrigation coverage by providing low-cost loans.

## WORLD METEOROLOGICAL DAY

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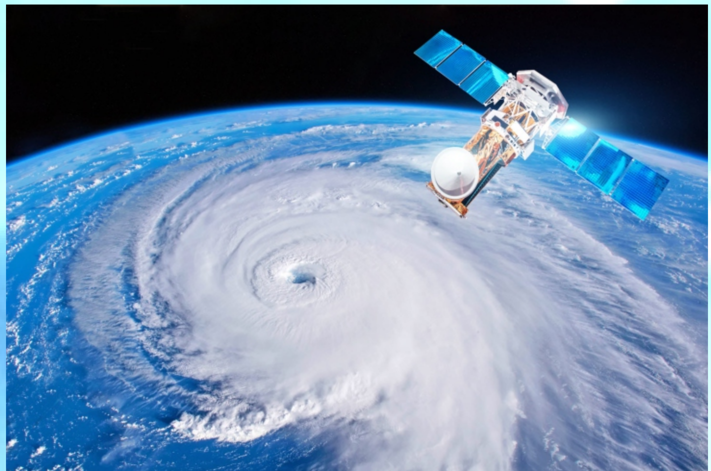


World Meteorological Day (WMD), observed annually on March 23rd, commemorates the establishment of the World Meteorological Organization (WMO) in 1950. This day highlights the critical role of meteorology in safeguarding lives, economies, and ecosystems. By fostering global cooperation and advancing scientific research, WMD underscores humanity's collective responsibility to address climate challenges. This essay explores the history, purpose, utility, and environmental impact of WMD, emphasizing its relevance to sustainable development.

WMD marks the anniversary of the WMO's creation, a United Nations agency dedicated to international collaboration in weather, climate, and water resource management. Each year, a theme is selected to address pressing global issues, such as “Early Warning and Early Action” (2022) or “The Future of Weather, Climate, and Water Across Generations” (2023). These themes guide discussions on leveraging meteorological science for societal benefit (WMO, 2023).

Meteorology is foundational to disaster risk reduction, food security, and climate resilience. Extreme weather events, intensified by climate change, claim thousands of lives annually. For instance, the WMO (2021) reported a fivefold increase in weather-related disasters since 1970, underscoring the need for robust early warning systems. WMD raises awareness about these challenges, advocating for equitable access to meteorological data, particularly in vulnerable regions.

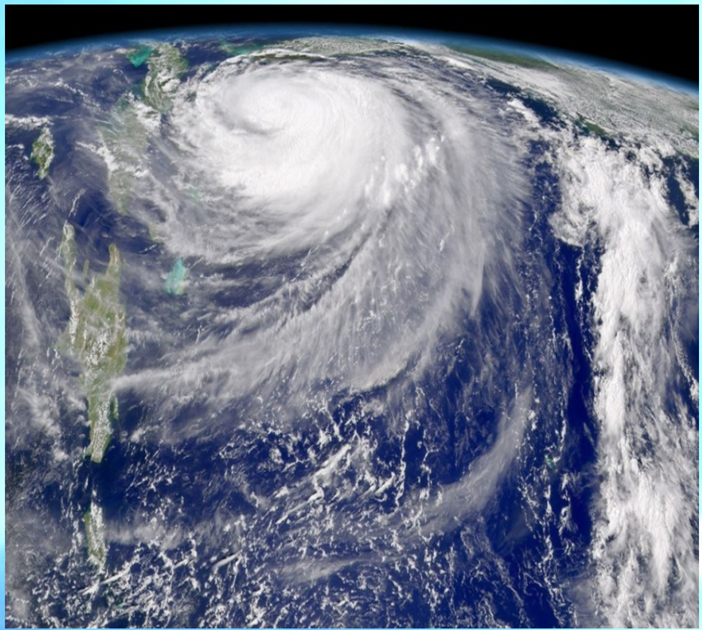
Activities range from educational workshops to policy forums. Governments and organizations release reports, such as the WMO's *State of the Global Climate*, to inform public discourse. Schools engage students through weather experiments, while media campaigns disseminate climate literacy. In 2023, the WMO launched the *Early Warnings

for All* initiative, aiming to protect every person from hazardous weather by 2027 (WMO, 2023).

**Utility and Environmental Impact**

1. **Disaster Preparedness**: Meteorological advancements have drastically reduced disaster mortality. For example, Bangladesh's cyclone early warning system lowered fatalities from 300,000 in 1970 (Bhola Cyclone) to fewer than 100 in recent storms (IPCC, 2022).
2. **Agriculture**: Climate forecasts enable farmers to optimize planting cycles, enhancing food security in regions like sub-Saharan Africa (FAO, 2020).
3. **Public Health**: Weather data predicts disease outbreaks; malaria forecasting in Africa uses rainfall patterns to target interventions (WHO, 2019).
4. **Climate Action**: The WMO's Global Atmosphere Watch monitors greenhouse gases, guiding policies under the Paris Agreement (UNFCCC, 2015).
5. **Economic Benefits**: Renewable energy sectors rely on weather predictions to optimize solar and wind energy output, reducing fossil fuel dependence (IRENA, 2021).

World Meteorological Day bridges science and society, emphasizing the interdependence of human and planetary health. By promoting innovation and inclusivity, the WMO empowers nations to combat climate change and achieve sustainable development goals. As global temperatures rise, the lessons of WMD—cooperation, preparedness, and resilience—are more vital than ever.



# MOLECULAR ASPECTS OF ROOTSTOCK-SCION INTERACTION IN RESPECT OF BIOTIC AND ABIOTIC STRESS

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**Introduction**

Important mechanisms taking place during grafting, such as tissue reconnection and vasculature formation, rootstock-scion communication, and genomic interactions. This assignment will emphasize on the important mechanisms taking place during grafting, especially the genomic interactions between grafting partners and the impact of rootstocks in scion's performance. Recent advances in plant science such as next- generation sequencing provide new information regarding the molecular interactions between rootstock and scion. The attachment of the two plant parts together is vital as the root quickly responses transcriptionally to the presence of the shoot even if vascular connection has not been established yet. Plasmodesmata are formed between the adhering cells of the grafted plant establishing transport and cell-to-cell communication between the two grafting partners.

Phylogenetic proximity or similarity in the vascular anatomy of the grafting partners does not seem to result always in grafting realization. It is shown that grafting is facilitated by the action of genes such as cellulases that help the reconstruction of cell walls; these genes can facilitate tissue adhesion and promote plant grafting. If plants possess or are bred to possess such genes in abundance, interfamily barriers in grafting could be lifted and grafting technology can be expanded to deliver more chimeric plants that will take advantage of both distantly related partners' advantages.

**Rootstock-scion interaction and biotic and abiotic stresses**

Different miRNA expression patterns in homoand hetero-grafted cucumbers grafted onto pumpkin rootstocks were detected under salt stress showing that miRNA regulation might be a result of salt stress adaptation. The rootstocks "110R," "1103P," and "99R" have been discovered to improvewater efficiency throughout critical periods of growth in grapevine, making them efficient in combating drought stress.

Grafting was found to enhance the diversity of the proteins released by roots in comparison to non-grafted plants and most of these proteins are implicated in biotic and abiotic stress resistances. The rootstock was found to be responsible for inducing drought tolerance in scion cultivars by up- regulating the transcription of genes associated with the cell wall, biotic and abiotic stress resistance, antioxidant systems and soluble carbohydrate, TFs, PKs, and the ABA signaling pathway, while down-regulating the activity genes involved in the light reaction, metabolic processes and biosynthesis of ethylene. Transcriptomic analyses suggested that all genes in the grafted stems that participate in the anthocyanin biosynthesis pathway as well as genes involved in the induction of high ethylene levels in grafted flowers were induced in comparison to the non- grafted controls. Thus suggesting that grafting and its stress-induced conditions can significantly alter development characteristics in vegetables. Rootstock-scion combination that was highly vigorous had vessels with larger diameters, xylem areas, and proportion of vessels with diameters, greater than 50 mm. The effect of scion variety on rootstock growth and development via signals stimulated in shoot has been studied. These signals regulating root elongation and development in model plants include metabolites, hormones peptides, HY5, microRNA 156, and microRNA 399. The reciprocal interaction between rootstock and scion has been proposed to be dependent on factors such as organ type, timing, or spatial distance. Rootstocks can influence fruit yield and biochemical traits of the fruit through their interaction with specific scions. In metabolomic analyses, the distribution of 6 out of 53 basic metabolites in the scion sap and 14 out of 55 in the rootstock sap were directly controlled by the rootstock. In contrast, 42 and 33 metabolites in the scion and rootstock saps, respectively, were significantly affected by the rootstock-scion interaction. This interaction also plays a critical role in modulating plant responses to various stresses, including both abiotic and biotic factors.

**Low temperature**

Low temperatures have a strong impact on the growth and geographical distribution of plants, and specially affect tropical crops. The acquired resistance to stresses in grafted plants is attributed to graftinduced changes in the root system. Changes in the expression of genes in tomato scions can be recorded early in the grafting process. Tomato heterografts and homografts have similar healing profiles and the examination of gene expression in tomato scions, 16 days after grafting, revealed many DEGs including those related to signaling and oxidative stress that were upregulated in the heterografted scions. The scion of cucumber plants can survive under chilling stress when it is grafted on pumpkin rootstock. Grafting improves the ability of precursors of amino acid and lipid biosynthesis to supply energy for cucumber in early chilling stress. It has been found that abiotic stress directly inhibits amino acid biosynthesis and metabolism. The co-relationship study between pumpkin and cucumber plants revealed that four key chilling-induced pumpkin mobile mRNAs were highly related to glycine, serine, and threonine synthesis and fatty acid β-oxidative degradation metabolism in cucumber tissues. Citrus transcriptome investigations comparing coldresistant vs. sensitive rootstocks revealed that ABA has a role in signalling and activating cold scion adaptation. The concentration of free sugars and proline content were much higher in the Carrizo citrange rootstock, according to the metabolomic research. Hormone measurement in roots revealed a significant increase in ABA content in Carrizo citrange roots under cold exposure, which was not seen in scion *C. macrophylla*.

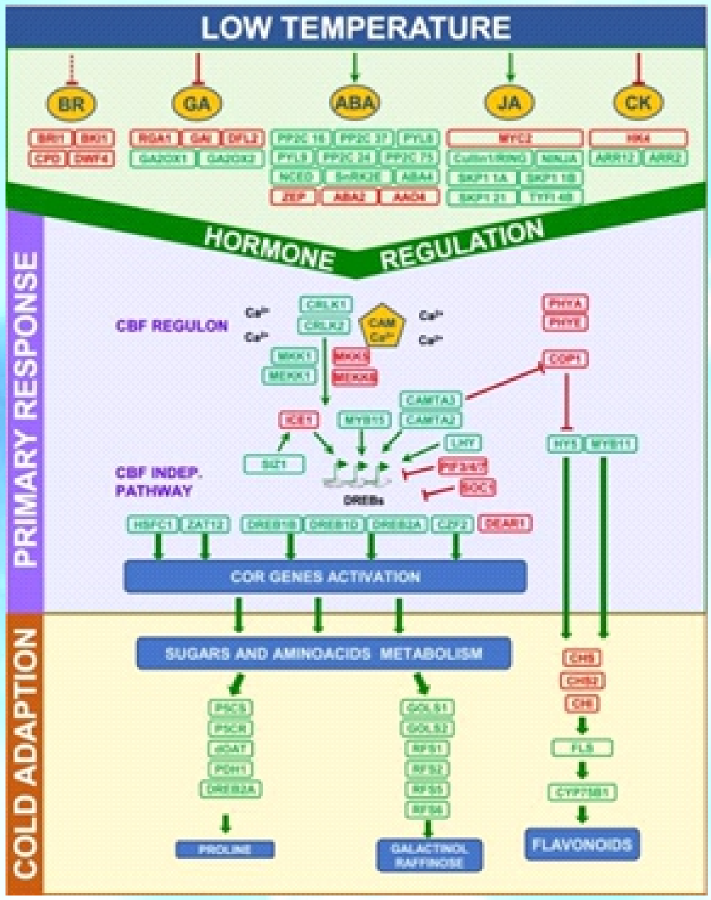


**Fig:1 Summary figure including the most important DEGs and pathways that changed during long- term cold stress in citrus grafted plants. DEGs in green color represents genes that increased its expression and DEGs in red color represents genes that decreased its expression.**

**Drought and high temperature stress**

The combination of drought and heat stress is harmful to various crop species, resulting in significant production decreases. Carrizo, as a rootstock, increases the metabolic and hormonal response of Cleopatra scions to the stress combination (drought and heat). Whereas, Cleopatra as a rootstock reduces levels of raffinose, galactinol, proline, phenylalanine and tryptophan in Carrizo scions, which impairs plant tolerance to the drought and heat stress.

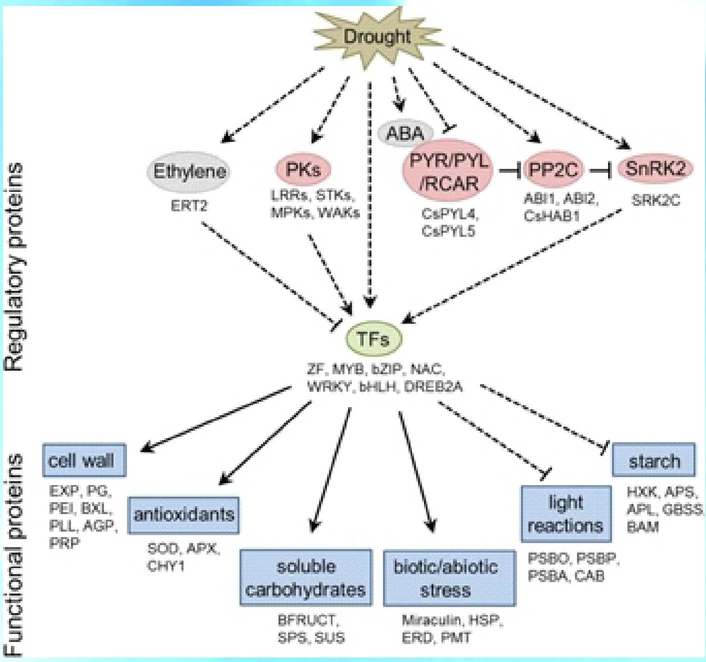


**Fig: 2: A schematic model of the rootstock-induced transcriptional response associated with drought tolerance in leaves of sweet orange.**

**Salt stress**
Different miRNA expression patterns in homoand hetero-grafted cucumbers grafted onto pumpkin rootstocks were detected under salt stress showing that miRNA regulation might be a result of salt stress adaptation.

**Disease**
A study including transcriptomic analysis in tomato has proven that grafted plants can recover from potato virus Y (PVY) infection independently of whether a susceptible or a tolerant variety is used as rootstock or scion. It appears that in the case of the tolerant variety, its favorable tolerance to viral infection is augmented by grafting changing its transcriptome, while it can be also effectively delivered to a susceptible scion. It appears that tolerant varieties with their special coping mechanisms against viral infections can act cumulative and/or synergistically in grafting. The apparent movement of sRNAs inside grafted plants could also have vast practical implications. For example, resistance to viruses has been shown to be transmitted from the rootstock to scion in tomato. Resistant scions with reduced accumulation of Tomato spotted wilt virus (TSWV) RNA were successfully produced by grafting onto a resistant tomato rootstock known for its enhanced RNA interference (RNAi) response to viral infection. Quantitative RT- PCR analysis revealed that key genes involved in the RNAi pathway, such as Argonaute (AGO) and RNA-dependent RNA polymerase (RDR), were upregulated in the roots of these resistant grafted plants. This suggests a systemic activation of antiviral defense mechanisms mediated bythe rootstock. Interestingly, the authors found that RNA silencing was also stronger in the self- grafted plants showing that even grafting it could provoke the activation of the mechanism. The role of rootstock in disease management is critical and vital, as it directly save the plants from infection and improves fruit crop productivity. Most citrus scion cultivars are highly sensitive to Huanglongbing (HLB), while certain rootstock cultivars, particularly those with trifoliate orange (Poncirus trifoliata) parentage, exhibit greater tolerance. Citrus trees grafted onto such tolerant rootstocks generally show reduced HLB-associated damage compared to those grafted onto more susceptible rootstocks. Under greenhouse conditions, various sweet orange–rootstock combinations infected with Candidatus Liberibacter asiaticus demonstrated differential effects on scion performance, highlighting the significant role of rootstock choice in modulating disease severity and scion response. Tree decline is caused by a disruption in glucose metabolism. Amino acid, fatty acid, shikimate, and other secondary metabolite pathways have also been discovered to be altered by HLB infection.

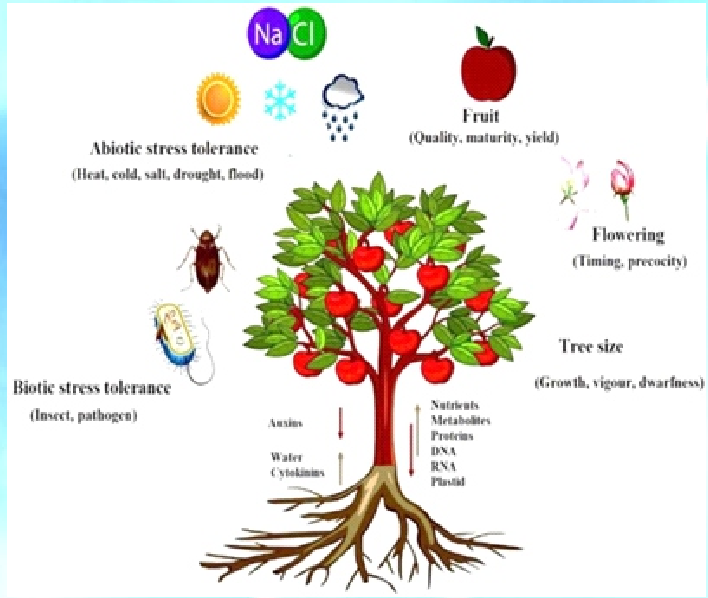


**Fig. 3: Macromolecules DNA, RNA, protein, hormones, and plastid DNA bidirectional movement via graft union explain the role of molecular and hormone signaling and also explain the effect of scion–rootstock relationship on quality fruit production.**

**CONCLUSION**
Grafting interactions are complex. Emerging research studies show that grafting changes gene expression that impacts scion's phenotype. It also suggested that often the interaction of genotypes has a significant impact on grafted plants performance. It seems that this specific interaction forms certain transcriptomic patterns on grafted plants that often lead to a total reprogramming of gene expression.

# A COMPREHENSIVE OUTLOOK ON PGRS UNDER ABIOTIC STRESS

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**Abstract:**
Plant growth regulators (PGRs) play critical roles in mediating plant responses to abiotic stresses, including drought, salinity, temperature extremes, and flooding. Among these PGRs, abscisic acid (ABA) stands out for its pivotal role in stress adaptation, regulating processes such as stomatal closure, root hydraulic conductivity, and stress-responsive gene expression. Cytokinins, gibberellins, auxins, ethylene, brassinosteroids, and polyamines also contribute to stress tolerance through various mechanisms, including modulation of hormone levels, regulation of stomatal aperture, and induction of stress-responsive proteins. Recent research has advanced our understanding of the biosynthesis, metabolism, and signaling pathways of these PGRs under stress conditions, highlighting their potential for improving crop resilience. Emerging evidence suggests the involvement of salicylic acid, jasmonic acids, strigolactones, and their interactions with other PGRs in plant stress responses. This write up provides insights into the multifaceted roles of PGRs in plant stress tolerance and their intricate regulatory mechanisms for sustainable crop production in challenging environments.

Introduction: Plant responses to abiotic stress are complex, reflecting the integration of stress effects and responses across various levels of plant organization. The regulatory roles of plant growth regulators (PGR) are among the crucial and extensively discussed aspects of abiotic stress tolerance. Plant growth hormone, a natural signaling molecule, is widely acknowledged for its intricate role in regulating growth, physiology, development, morphology, and responses to abiotic stress. Acting as a complex transduction agent, it sustains optimal plant growth and development, making it pivotal in plant reactions to both abiotic and biotic stresses. The plant hormones commonly related to stress responses are abscisic acid (ABA), ethylene (ET), salicylic acid (SA), etc. While ABA has been mainly involved in the regulation of abiotic stress responses, ET, SA, and JA have been associated with responses of defense against pathogens, insects, or wounding. Auxins (AXs), cytokinins (CKs), gibberellins (GAs), brassinosteroids (BRs), and strigolactones (SLs) are also required in stress-triggered responding networks. Advancements in physiochemical techniques, molecular biology, and genetic approaches havefacilitated significant progress in understanding PGR's role in plant adaptation to abiotic stresses.

Role of Abscisic Acid (ABA): ABA plays a pivotal role in plant responses to various abiotic stresses, including drought and salinity. Its synthesis and degradation are finely regulated by developmental and environmental cues, determining its availability within the plant. ABA facilitates adjustments in stomatal function, root hydraulic conductivity, photosynthesis, biomass allocation, osmolyte production, and the synthesis of stress-responsive proteins and genes, ultimately enhancing stress tolerance. The biosynthesis of ABA occurs through the carotenoid biosynthetic pathway, starting from farnesyl pyrophosphate and a C40 carotenoid. Under stress conditions, there is an increase in the activities of enzymes associated with ABA biosynthesis, leading to its accumulation. Conversely, ABA degradation is inhibited under stress, contributing to its elevated levels. ABA levels are also regulated by its irreversible degradation into phaseic acid (PA) and dihydrophaseic acid (DPA), or reversibly into inactive derivatives. PA and DPA levels increase parallel to ABA under stress, even after ABA content plateaus. Upon rehydration, ABA levels decrease while PA and DPA levels either increase or remain stable. Drought and salinity stress trigger ABA accumulation in plant leaves, facilitating water conservation through stomatal closure and enhanced root hydraulic conductivity. ABA also coordinates communication between roots and aboveground parts, predominantly influenced by soil moisture levels. Stomatal sensitivity to ABA varies among plant species and is influenced by factors like leaf age, climate, nutrition, and xylem sap composition. Stomatal aperture regulation depends on the turgor potential of surrounding cells, with ABA playing a crucial role in reducing water loss through transpiration by promoting stomatal closure. ABA regulates guard cell volume by balancing $K^+$ influx or efflux and is associated with cellular electrical changes and pH alterations. It also induces nitric oxide production and $H_2O_2$ involvement in stomatal closure. ABA facilitates root-to-shoot communication under stress conditions, influencing the ratio between root and shoot growth. Under stress, plants undergo metabolic changes, leading to the synthesis and accumulation of various stress-responsive proteins like LEA proteins, dehydrin, and lipid transfer proteins. ABA plays a central role in the induction of these proteins. These proteins aid in cellular protection and detoxification during dehydration.

Role of Cytokinin: Cytokinins is vital for seed germination, morphogenesis, chloroplast biogenesis, and stress response, are primarily synthesized in roots. They are N6-substituted adenosine compounds synthesized via t-RNA pathways. Their levels are regulated through conversions and catabolism. Under stress, cytokinin concentrations decrease. Stress-induceddeclines in cytokinins affect root nodulation and are influenced by factors like stress severity and growth stage. Drought stress typically reduces cytokinin transport from roots to shoots, impacting various physiological processes like senescence and stomatal conductance. Salinity stress also reduces root cytokinin content, affecting root-shoot balance. Overexpression of the ipt gene, which is crucial for cytokinin biosynthesis, enhances stress tolerance in various plants. Increased cytokinin levels lead to improvements in drought and low temperature tolerance by regulating metabolite accumulation and ROS scavenging enzymes. Cytokinins play a role in regulating stomatal aperture by antagonizing ABA action, influencing processes like stomatal closure and leaf senescence. Cytokinins modulate guard cell membrane potential and intracellular signaling, affecting stomatal opening and transpiration rate.

**Role of Gibberellins:** Gibberellins, tetracyclic diterpenoid carboxylic acids, regulate various developmental processes such as elongation, germination, flowering, and leaf senescence. The main bioactive forms are GA1 and GA4. They are synthesized from trans-geranylgeranyl diphosphate via the methyl erythritol phosphate pathway and undergo oxidation by enzymes like GA20ox, GA2ox, and GA3ox. GA2ox genes are particularly responsive to developmental events and stress. Chemical growth retardants inhibit gibberellin biosynthesis and enhance drought tolerance in crops. Applying gibberellins to retardant-treated plants or GA-deficient mutants counteracts the effects of growth retardants. Studies suggest that gibberellins may interact with other phytohormones like auxin and abscisic acid (ABA) to modulate stress responses. Paclobutrazol, a gibberellin biosynthesis inhibitor, has been found effective in improving drought tolerance in various crops. Gibberellins also play a role in submergence tolerance of aquatic plants by regulating ethylene and ABA biosynthesis. Therefore gibberellins are involved in complex signalling pathways that mediate plant adaptation to different environmental stresses.

**Role of Auxins:** Auxins, such as indole acetic acid (IAA), are crucial for various plant developmental processes and respond to abiotic stress. They are mainly synthesized in meristematic tissues and their levels are regulated by degradation, conjugation, and transport. Abiotic stresses like salinity and high temperature can alter auxin levels, affecting plant growth and stress responses. Exogenous application of auxins has been shown to mitigate the adverse effects of salt stress on seed germination and plant growth. Additionally, auxins play a role in cold stress tolerance, with changes in auxin homeostasis influencing ABA synthesis and stress responses. The interaction between auxins and ethylene contributes to adventitious root formation under flooding stress. Molecular studies have revealed cross-talk between auxinsignaling pathways and responses to cold and salt stress, with PIN proteins and auxin- responsive genes being implicated in stress tolerance mechanisms.

**Role of Ethylene:** Ethylene, a fundamental gaseous hormone in plants, regulates various developmental processes such as pollination, seed germination, and fruit ripening. It is synthesized from methionine via intermediates like S-adenosyl methionine (SAM) and 1-amino cyclopropane-1-carboxylic acid (ACC) through enzymes ACC synthase and ACC oxidase. Under stress, ethylene production increases, aiding plants in coping with adverse conditions like drought, salt, cold, and flooding. However, its effects vary depending on factors like stress intensity and duration. Ethylene modulates gene expression via ERF proteins, influencing responses to abiotic stresses such as cold, drought, and salinity. Certain ERF proteins enhance stress tolerance, while others regulate ethylene homeostasis. In destination organs, ET triggers a signaling cascade through ethylene receptors, including ERS1, ERS2, ETR1, ETR2, and EIN4. In the absence of ET, these receptors bind to kinase protein (CTR1), but in its presence, CTR1 inhibition is relieved, leading to the induction of numerous transcription factors. Ethylene response factors (ERFs) are the downstream components of ET signaling pathways and play essential roles in abiotic stress responses by regulating stress tolerance genes. Thus, ET regulates leaf development, senescence mechanisms, fruit ripening, and germination in some species under stressful conditions, with ACC serving as a long- distance root-sourced signal under stress.

**Role of Brassinosteroids:** Brassinosteroids (BRs) are potent plant growth regulators categorized as polyhydroxy steroidal compounds. Over 70 compounds have been identified, with 28-homo-brassinolide, 24-epibrassinolide, and brassinolide being the most bioactive. Brassinosteroids are plant hormones similar to animal steroids, which have unique properties that promote growth. They play crucial roles in various plant processes such as cell elongation, division, photomorphogenesis, and stress responses. They are particularly effective in helping plants withstand harsh conditions like drought, salt stress, and extreme temperatures. BRs play pivotal roles in various developmental processes such as shoot and root growth, floral initiation, and fruit development. Recent studies demonstrate their potential in inducing antioxidant defense mechanisms, reducing reactive oxygen species (ROS) accumulation, and enhancing photosystem protection during plant abiotic stress responses. Additionally, BRs modify cellular wall architecture and membrane adjustments, preserving membrane functionality under adverse environmental conditions. BR signaling involves the activation of stress-responsive transcription factors regulated by a negative regulator called BIN2, which activates numerous stress tolerance genes.The synthesis of brassinosteroids involves two pathways, leading to the production of active forms. These hormones can be modified by attaching sugar and lipid molecules to enhance their effectiveness. The exact mechanism by which brassinosteroids confer stress tolerance is not fully understood, but it involves complex biochemical reactions. They may activate or suppress enzymes, stimulate protein synthesis, and induce the production of defense compounds in plants. Research suggests that applying brassinosteroids externally can improve plant responses to stress. For example, they enhance root nodulation in beans under drought stress by increasing cytokinin synthesis. They also reduce oxidative damage in plants under drought and salt stress by boosting the activity of antioxidant enzymes. Brassinosteroids also help plants cope with high temperatures by increasing the production of heat shock proteins and protecting important enzymes involved in photosynthesis. They contribute to chilling tolerance by regulating protein expression and enhancing membrane stability.

**Role of Polyamines:** Polyamines are essential molecules in plant growth, involved in various developmental processes like organ formation, flowering, and root development. They are produced through the decarboxylation of amino acids, leading to the formation of putrescine, spermidine, and spermine. These molecules play a role in signal transduction pathways, interaction with transcription factors, and regulation of protein kinases. Polyamines and ethylene synthesis are closely linked, sharing a common precursor, SAM (S- adenosylmethionine), and they tend to inhibit each other's biosynthesis and action. Under stress conditions like drought, salinity, flooding, heat, and chilling stress, plants increase their levels of polyamines to enhance tolerance. This increase helps stabilize membrane integrity, regulate hormonal balance, induce antioxidant enzymes, and reduce oxidative stress. Different plant species respond differently to stress, with some accumulating higher levels of spermidine and spermine under salt stress, while others show changes in putrescine levels. Exogenous application of polyamines can mimic this response, helping plants cope with stress-induced changes in growth and cellular functions. Polyamines also play a role in flooding tolerance by stimulating PM ATPase activity, improving cell homeostasis, and nutrient acquisition. They contribute to thermotolerance by stabilizing membrane structure, regulating photosynthetic efficiency, and downregulating ethylene production. Genetic studies have shown that mutations in genes involved in polyamine biosynthesis can affect plant responses to stress. Overexpression or mutation of these genes can alter polyamine levels and influence stress tolerance. Transcript profiling has revealed that stress-induced changes in polyamine levels are regulated by ABA, a stress hormone, which modulates polyamine metabolism at the transcriptional level.

**Role of Other PGR's:** Several researches have highlighted the role of salicylic acid and jasmonic acids in plant responses to environmental stresses. Salicylic acid and jsamonic acid mitigate sodium influx, oxidative damage, and osmotic stress in the plants exposed to salinity. Studies in Arabidopsis have characterized the signaling pathways of salicylic acid and jsamonic aid in response to stressful conditions. salicylic acid and jsamonic aid may intersect with abscisic acid (ABA) signaling pathways, forming a complex network in plant responses to abiotic stresses. Strigolactones (SLs), a group of plant growth regulators (PGRs) derived from carotenoids, serve as germination-stimulating compounds in root parasitic plants like Striga, Orobanche, and Phelipanche species. SLs application in certain plants indicates their potential role in abiotic stress tolerance by regulating growth, development responses, and nutrient distribution. Interactions between SLs and other PGRs, particularly auxins (AXs) and abscisic acid (ABA), are implicated in plant architecture, suggesting emerging evidence for cross-talk in signaling and function.

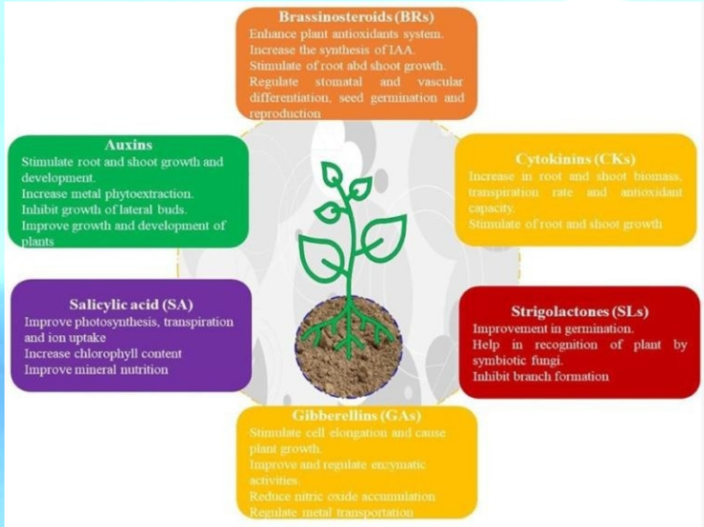


**Fig. 1: Overview of abiotic stress and effects on plant growth and development.**

**CONCLUSION:**

Plant hormones play crucial roles in regulating plant growth and development, especially under abiotic stress conditions. These stressors can alter hormone levels, which in turn affect various physiological processes such as stomatal functioning, water balance, nutrient allocation, and antioxidant defense mechanisms. The response of plants to stress varies depending on factors like cultivar, duration of stress, and intensity of stress. Stressed plants commonly exhibit increased levels of abscisic acid (ABA) and decreased levels of cytokinins, the responses of gibberellins, auxins, ethylene, and polyamines to abiotic stress factors can vary. Progress in molecular aspects of hormonal physiology has led to the identification ofgenes involved in PGR biosynthesis and their receptors. Understanding stress-induced changes in gene expression has been crucial in establishing the role of PGRs in plant adaptation to abiotic stresses. The roles of polyamines and brassinosteroids in regulating plant growth, development, and stress tolerance are well understood, further research is needed to unravel the mechanisms of their stress-protective roles.

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# NOTIFICATION NO. 1

## APPLICATIONS ARE INVITED FOR NESA ANNUAL AWARDS – 2025

**LAST DATE: 30th September, 2025**


This is to notify that applications are invited for the **NESA Annual Awards 2025** from the Life Members of the Academy. The prescribed application forms for the following categories can be downloaded from our website: www.nesa-india.org • https://nesa-india.org/nesa-annual-awards-2025/

Separate applications should be submitted for independent awards. For detailed guidelines the website of NESA may be approached by log in to website: https://nesa-india.org/nesa-annual-awards-2025/

**The last date for all the categories of awards is 30th September, 2025.**

The categories of Awards are given as under:

(1) NESA FELLOWSHIP AWARD - 2025
(2) NESA EMINENT SCIENTIST AWARD - 2025
(3) NESA DISTINGUISHED SCIENTIST AWARD - 2025
(4) NESA SCIENTIST OF THE YEAR AWARD - 2025
(5) NESA ENVIRONMENTALIST AWARD - 2025
(6) NESA GREEN TECHNOLOGY INNOVATIVE AWARD - 2025
(7) WOMEN EXCELLENCE AWARD - 2025
(8) NESA YOUNG SCIENTIST AWARD - 2025
(9) NESA JUNIOR SCIENTIST AWARD - 2025

**Contact for more details:**

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