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Editorial

As a part of holistic learning team ARIBAS took approach to look at Biotechnology in an integrated way. Not only understanding of the network of proteins, cross-talk between them and how they response to the stimulus; understanding of social networking, cross talk of science and creativity, how to respond to modern 'learn and let learn' environment is also being inculcated in ARIBAS students.

Techniques evolved in the post -omics era have given us opportunity to accelerate discovery process by looking at many cellular processes simultaneously. Advances in computational power, algorithms, and modern database mining techniques are accelerating the discovery science even more. New powerful techniques to study large number of genes and proteins at a time are getting more and more sophisticated. New strategies are emerging to identify the role of specific genes in causing and counteracting diseases.

It is impossible task to accommodate all available knowledge in the containment of theory and practical syllabus. Alternated way is community based learning using honey bee trait of collecting, reading, learning, assimilating, creating and disseminating knowledge for institutional as well as global peers. Quest is a small endeavor for the community based learning.

Quest is also intend to provide students of ARIBAS a platform to learn 'art and science of scientific writing'. It explores the ways of teachings students how soft skills can be used as a powerful tools in creating and shaping peer connections that helps to expand knowledge, deepen skills and enhance practice of science.

Index

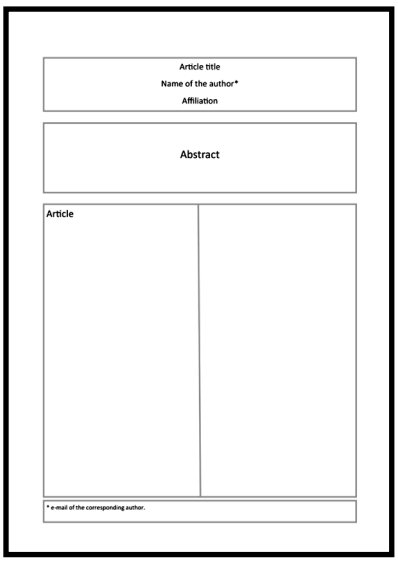
News & Views

Review Articles

Instructions to Authors

Manuscripts submitted to Quest should adhere to below mentioned criteria.
Research News: About 400 words (1 page)
Research/Review Article: About 2000 words (4 pages)

Common to all: -
Font: Calibri
Font Size: 14
Columns: 2
Column Spacing: 0.18
Line Spacing: 1
Margin: Narrow
References: 1) In text citing, S No, Superscript.
2) Author's name (s), *Journal name*, **Volume No**, Page No**,** (year).



Composting

It is the solid organic material derived as a product of degradation of organic wastes and plant products. A compost can be utilised as a soil supplement and as a fertilizer in agricultural processes.

Industrial By-product and other waste accumulation is raising grave concerns for the field of waste management, and the situation has arrived to such critical point that proficient scientific intervention for elucidation of the predicament that has befallen us. Current circumstances pose an obligation to adopt such technologies and strategies which are absolutely pertinent to process waste material for judicious extraction of resources out of it. In such processing, when the material of concern possesses biodegradability, composting processes secure serious consideration. One added consideration one gets while selecting composting as a waste disposal (rather utilisation) practice is the remarkably economical prices of this process.

Composting can be addressed through different approaches; Conventional to Enthralling research initiatives

Traditional Compost Pile

A pile of to be composted materials are heaped together and allowed to be degraded by the action of local microflora. At the most this pile may be covered with a layer of soil or cow dung slurry or both.

Windrow Composting

This piling technique utilized stacking of waste in long row like formations. This technique is efficient as very large amount of waste can be treated simultaneously.

Bio-Drying

It is a process where bio-degradable materials are subjected to higher temperatures during the initial stages of composting through microbial activities or forced aeration resulting into reduction of weight.

Composts are conceived as a potential source of essential supplements and experimentations are being carried out to enhance the bioavailability of components this latent nutritive pool.

Related Stories

Industrial waste based compost as a source of novel cellulolytic strains and enzymes

Highly productive and Thermotolerantstrain *B. amyloliquefaciens* B31C was successfully isolated. This strain also exhibits higher enzymatic activity when the experimental temperature was altered from 28 to 37°C. Through proteomic analysis a specific enzyme, an endoglucanase was identified. It was shown that the purified enzyme catalyzes carboxymethylcellulose's hydrolysis following Michaelis–Menten kinetics with a K_M of 9.95 mg ml^{-1} and a v_{max} of 284 µM min^{-1}. It shows retention of 90% of its activity for at least 144 h of incubation at 40 °C and exhibits a range of optimum temperatures from 50 to 70 °C.

Impact of Indigenous industrial compost on the growth of coarse and fine rice varieties under saline environment.

Pakistani Rice is categorized as salt-sensitive plant as its growth is significantly reduced under salt toxicity. The effect of exogenous application of indigenous industrial compost (IIC) on the coarse (IRRI-9) and fine (Super basmati-2000) rice varieties under salt stress

was investigated in this study. The compost application significantly improved ($p<0.01$) dry matter four times as compared with control. In the same way, paddy yield increased three folds both under normal as well as saline growth medium.

Changes in Maize (Zea mays L.) Performance and Nutrients Content with the Application of Poultry Manure, Municipal Solid Waste and Ash Composts

The composting of the organic wastes was done using poultry manure, municipal solid waste (sorted) and ash, respectively. The finished compost was applied to the maize in polythene bags. Maize seeds were planted and periodically, soil samples were collected. Standard laboratory analysis was carried out on experimental soil, compost and maize plants samples. The mean plant height, root length and number of roots of maize planted on the control (soil only) were significantly ($P<0.05$) lower than those on all the compost fertilized treatments from 14 to 42 days after planting (DAP). Dry matter (%) of maize plant at 42 DAP indicated significant differences ($P < 0.05$) among all the treatments.

Contributed by Samyak Chaturvedi, IG-GBT 9th Sem

The effect of climatic changes on plants

Alterations in climate have always had its impact on our ecosystem. Therefore, this has been the area of interest for the researchers and environmentalists ever since it has been known. The effect of climate change on plants is also explored a lot and it still continues.

The highly covered topics under these researches are response to elevated CO_2 concentration; interactions with climate change variables and air pollutants; impacts of increased climate variability and frequency of extreme events; the role of weeds and pests; disease and animal health; issues in biodiversity; water, soil fertility and erosion; and vulnerability of soil carbon pools.

At the plot level, and without considering changes in the frequency of extreme events, moderate warming may benefit crop and pasture yields in temperate regions, while it would decrease yields in semiarid and tropical regions. Modeling studies indicate small beneficial effects on crop yields in temperate regions corresponding to local mean temperature increases of 1–3°C and associated CO_2 increase and rainfall changes. By contrast in tropical regions, models indicate negative yield impacts for the major cereals even with moderate temperature increases (1–2°C). Further warming projected for the end of the 21st century has increasingly negative impacts in all regions.

Hundreds of studies conducted over the last 30 years have confirmed that plant biomass and yield tend to increase significantly as CO_2 concentrations increase above current levels. Such results are found to be robust across a variety of experimental settings, such as controlled environment closed chambers, greenhouses, open and closed field top chambers, and free-air carbon dioxide enrichment (FACE) experiments. Elevated CO_2 concentrations stimulate photosynthesis, leading to increased plant productivity and modified water and nutrient cycles. Experiments under optimal conditions show that doubling the atmospheric CO_2

concentration increases leaf photo-synthesis by 30%–50% in C_3 plant species and 10%–25% in C_4 species. Although, Crop yield increase is lower than the photosynthetic response.

Plant physiologists and modelers alike recognize that the effects of elevated CO_2, as measured in experimental settings and subsequently implemented in models, may nonetheless overestimate actual field and farm-level responses, because of many limiting factors such as pests, weeds, nutrients, competition for resources, soil water and air quality, etc… which are neither well understood at large scales, nor well implemented in leading models. Future crop model development should therefore strive to include these additional factors to allow for more realistic climate-change simulations. Increased frequency of heat stress, droughts, and floods negatively affect crop yields and livestock beyond the impacts of mean climate change, creating the possibility for surprises, with impacts that are larger and occurring earlier than predicted.

The demand for water for irrigation is projected to rise in a warmer climate.

Increased temperature increases the turnover rate of organic matter which may lead to buildup of inorganic nitrogen in the soil and increased risk of nitrate leaching. Drier soil conditions increases the vulnerability to wind erosion.

Recent studies have shown that climate change has altered phenology of various fruits, mainly apples, decreasing its acid concentration, fruit firmness and development.

One important aspect that most models lack is that experimentally observed crop and pasture physiological responses to climate-change variables at plot and field levels are too simplified. As a consequence, the potential for negative surprises is not fully explored, thus reducing the level of confidence in regional and global projections. Key interactions that need further emphasis include:

- Nonlinearity and threshold effects in response to increases in the frequency of extreme events under climate change.
- Modification of weed pest and disease incidence.
- Field response of crops to elevated CO_2 concentration.
- Interactions of climate and management variables with elevated CO_2.

Contributed By Shivani Bhardwaj, IG-EBT 7th Sem

Mechanism and impact of oxidative process in extrusion coating

Extrusion Coating of Polyethylene generally takes place at elevated temperatures in order to create a polar (= oxidized) surface of the molten PE film to enable adhesion to the polar surface of the substrate. The Extrusion Coated material is often submitted to a number of additional process steps in which extra oxidation of the coated PE surface may take place. These additional process steps can comprise of e.g. corona treatment and sealing. In all the above processes it is essential to master the processing conditions in order to avoid over oxidation of the PE; over oxidation results in too much X-linking and wax formation, which can cause negative effects in terms of web stability, adhesion, printing, gluing and sealing. The benefits of ATR IR and ESCA surface analysis techniques to determine oxidation levels and gives recommendations on the limits of these oxidation levels of the PE surfaces in the various process steps.

ATR IR analysis techniques are applied to try to determine the oxidation levels of the Extrusion Coated PE- surfaces; often without success. ESCA analysis techniques is additional tools to determine the oxidation levels of coated PE surfaces. More and more ESCA has proven to be a powerful tool for troubleshooting and optimization purposes, as this analytical technique makes it possible to accurately analyze the oxidation status of the upper few nanometers of the PE layer studied whereas ATR IR more or less analyses the "bulk", which reduces the chance of "seeing" the degree of oxidation of the very surface.

Extrusion coating PE grades are usually not only moderately stabilized. High temperatures are deliberately chosen to oxidize the PE in order to match the PE surface with the (mostly) polar surface of the substrates to achieve a good adhesion. High temperatures not only cause oxidation of the PE: also X-linking and wax formation (chain break) will take place.

* Oxidation leads to e.g. saturated and unsaturated alcohols, aldehydes, ketones and carboxylic acids. On the one hand these components create the necessary polarity for a good adhesion; on the other hand they may have a negative influence on the organoleptical properties of the coated material when coating has taken place at too high temperatures.
* Oxidation leads to X-linking. Too high temperatures may lead to increase in viscosity, leading to web instabilities. Too high surface oxidation causes sealing problems because of the relatively increased zero viscosity.
* Oxidation leads to wax formation. This wax is "squeezed" to the surface of the PE coating. At too high temperatures the amount of wax can be so large, that it creates a weak boundary layer, negatively influencing adhesion, sealing, gluing and printing.

***ATR-IR-** ATR IR stands for Attenuated Total Reflexion Infra-Red spectrometry. The present modern ATR IR- equipment makes it possible to easily analyze the coated PE surface. As ATR IR analyses a layer with a depth of several microns, it will be clear that the resulting oxidation degree has to be seen as an average value for a relatively thick layer of PE.

***ESCA-** ESCA stands for Electron Spectroscopy for Chemical Analysis. By means of ESCA a surface layer only several nanometers thickis analyzed. This means that this technique is very helpful to examine adhesion, blocking, sticking, printing, gluing and sealing phenomena. In general ATR IR gives information about the bulk of the coated PE, while ESCA gives information about the very surface of the coated PE.

Contributed By Ankit Rathod, IG-IBT 9th Sem

Paclitaxel-loaded nanoparticles: Anti-proliferative activity and molecular interactions on prostatic cancer cells.

Prostate cancer is the most frequently diagnosed in men in Europe and the United States. Anti-androgenic therapies are effective for hormone-dependant prostate cancer. But for the hormone-refractory prostate cancer (HRPC) it is necessary to develop novel therapeutic strategies. Taxanes, including paclitaxel, are anti-cancer drugs approved for the treatment of prostate cancer but which have limited clinical application due to their hydrophobicity, their low therapeutic index. For that new paclitaxel-loaded small PLGA Poly (lactic-co-glycolic acid) nanoparticles, between 49 nm and 95 nm in size and with positive or negative surface charges, were prepared without detergent. Positive can be prepared by the loading of CTAB on to the surface. These nanoparticles are bio-degradable and bio-compatible as they liberate lactic acid and glycolic acid after hydrolysis in cell/blood stream, can be utilized in metabolic pathway. Different methods are used in the production of nanoparticles like O/W or W/O/W emulsion. Paclitaxels are loaded while preparing the nanoparticles. Drug release profiles for a system of PLGA/PLA micro particles encapsulating a hydrophobic drug, the three important properties affecting release behavior were identified as: polymer hydrophobicity, particle size and particle coating. Increasing the polymer hydro-phobicity & particle size, coating the particles, reduces the initial burst and increases the rate of release. Various combinations of the above three properties were used to achieve in-vitro release of drug over a period of 8 days, 25 days, and >40 days and steady release rate over the entire period of release. The drug release of paclitaxels a maintained in their "therapeutic window".

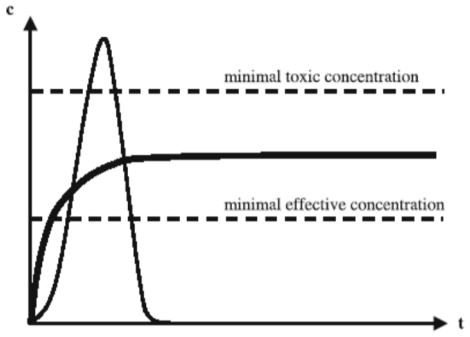


Figure: Schematic presentation of the "therapeutic window" of a drug and possible drug concentration time profiles upon administration of oral immediate (*thin curve*) and parenteral controlled release dosage forms (*thick curve*) (*c* denotes the drug concentration at the site of action in the human body, *t* the time after administration)

So that the drug does not show any toxic effect. These paclitaxel loaded nanoparticles are then studied on the in vitro PC3 cell line. This cell line is of the prostate cancer. These show the different effect like drug release, biodegradation of drug than the water in vivo experiment. This nanoparticle mode of delivery highly improves paclitaxel efficiency by up to two log-increases. This experiment also shows that negative nanoparticles are more effective, smaller in size and having low degradability than the positive nanoparticles.

Contributed By Miti Shah, IG-IBT 9th Sem

Ischemia and Reperfusion Injury; The killer of the Modern Times

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Abstract: Ischemia is a condition in which there is restricted blood supply to the tissue due to thrombosis or embolism. Due to this restriction in blood supply there is lack of oxygen, glucose and nutrients in the tissue causing damage to the tissue. Ischemia contributes to the pathophysiology of many conditions like myocardial infarction, peripheral vascular insufficiency, stroke, and hypovolemic shock. Prolonged ischemia results in cellular metabolic changes such as decrease in cellular oxidative phosphorylation which results in the failure to resynthesize ATP and phosphocreatine like energy rich phosphates. Ischemia also induces proinflammatory state which further increases the tissue injury on reperfusion[1]

Introduction

Cerebral ischemia is a condition in which sufficient blood flow to the brain is unable to fulfill the metabolic demand. This leads to poor oxygen supply or cerebral hypoxia and thus to the death of brain tissue causing cerebral infarction or ischemic stroke. Neurons located in the ischemic core die within minutes after the ischemic episode. Ischemia leads to alterations in brain metabolism, reduction in metabolic rates, and energy crisis[2].

Symptoms

The main symptoms involve impairments in vision, body movement, and speech. Symptoms of brain ischemia can include unconsciousness, blindness, problems with coordination, and weakness in the body[2].

Types of Cerebral Ischemia

Stroke is defined by the World Health Organisation as "a focal (or at times global) neurological impairment of sudden onset, and lasting more than 24 hours (or leading to death) and of presumed vascular origin". Based on patophysiology, three types of stroke exist: ischemic stroke from a vascular occlusion (approximately 80%), primary intracerebral haemorrhage (approximately 15%) and subarachnoid haemorrhage (approximately 5%) [3].

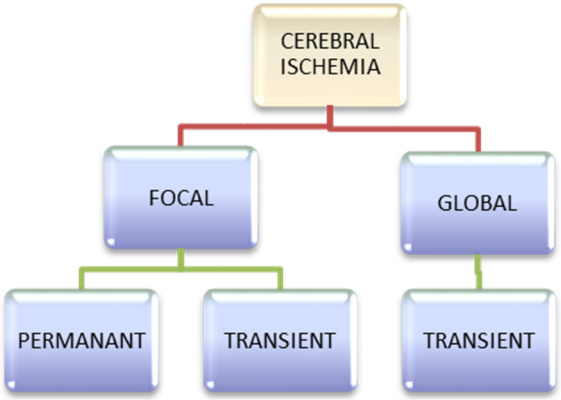

Figure 1: Types of cerebral ischemia

Ischemic stroke is caused by either thrombosis or embolism. Thrombosis is the formation of a blood clot (thrombus) inside a blood vessel, leading to an obstruction of blood flow. Embolism occurs when an embolus is transported through the circulation, eventually resulting in the occlusion of a blood vessel in another part of the body. In addition to stroke, there are other pathological conditions that can cause cerebral ischemia. These include e.g. cardiac arrest and complications during surgery. Stroke is the third most common cause of death worldwide after ischemic heart disease and

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cancer. Due to an increase in the proportion of elderly people and the future effects of smoking patterns in less developed countries, stroke mortality is estimated to double by the year 2020. Following a stroke, patients often suffer from impairments of motor functions and sensory functions of the body contralateral to the site of lesion. Other common symptoms include speech disturbances, perception disorders and cognitive disturbances. Most patients partially recover after a stroke, but complete recovery is seldom achieved. Today, the only specific treatment for stroke patients is thrombolysis with recombinant tissue plasminogen activator (tPA). However, this treatment can only be used in a small fraction of patients. Despite intensive research, there is no treatment paradigm that can reduce the cellular loss associated with an ischemic lesion and all clinical trials of neuroprotective drugs for the treatment of acute stroke have been unsuccessful. Therefore, the interest in new aspects of recovery, including lesion-induced neural plasticity and regeneration has increased[3].

Pathophysiology of Cerebral Ischemia

The brain is an organ that has high demands for oxygen and glucose. This makes the brain very sensitive to reduced perfusion. An acute interruption of blood flow during stroke results in rapid energy depletion since both oxygen and glucose are required for the production of ATP. The infarct core extends from the site of the lesion and is defined by low perfusion and high levels of cell death. This region is surrounded by the penumbra, in which some residual blood supply is present due to collateral circulation. Cells in the infarct core are generally considered to be beyond rescue, while many of the cells in the penumbra region can be salvaged if appropriate reperfusion occurs[4,5]. The energy depletion after an ischemic lesion initiates a cascade of pathophysiological events, including excitotoxicity, peri-infarct depolarisations, inflammation and apoptosis.

Excitotoxicity

Excitotoxicity is well established as an important trigger and executioner of tissue damage in cerebral ischemia[6]. This process is characterised by high concentrations of excitatory amino acids, in particular glutamate, in the extracellular space. Glutamate is the major excitatory neurotransmitter in the vertebrate brain.

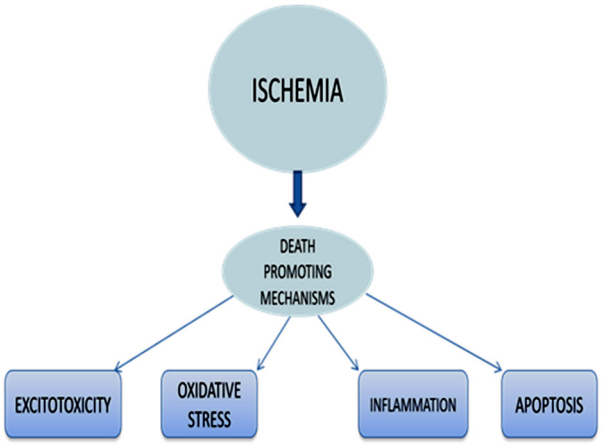

Figure 2: Diagram showing the death promoting mechanisms causing ischemia[2]

The actions of glutamate are mediated by two main types of receptors; ligand-gated cation channels (NMDA, AMPA and kainite receptors) and metabotropic glutamate receptors. Energy depletion inhibits the activity of ATP-dependent ion pumps, making it difficult for cells to maintain ionic gradients[7]. This results in depolarisation of neurons, leading to synaptic release of glutamate. In addition, transporter-mediated glutamate homeostasis is dramatically impaired after ischemia[8] and glutamate uptake can even be reversed[9], further increasing the concentration of extracellular glutamate. High levels of glutamate result in an abnormal stimulation of NMDA- and AMPA-receptors, which leads to increased influx of Ca^{2+} and Na^{+}. To balance this influx of cations, H_2O and Cl^{-} are transported into the cell. This results in cell

swelling and can lead to necrosis if the lesion is severe. The influx of Ca^{2+} also induces neuronal nitric oxide synthase (nNOS), resulting in the formation of reactive oxygen species such as peroxynitrite. Reactive oxygen species damage DNA which in turn activates poly (ADP-ribose) polymerase-1 (PARP-1). The activation of this enzyme is responsible for the translocation of apoptosis-inducing factor (AIF) from the mitochondria to the nucleus, which, in turn, initiates processes of active cell death[10]. Traditionally, excitotoxicity has been considered to cause a necrotic process. However, recent studies suggest that excitotoxic necrosis and apoptosis can be triggered in parallel in the ischemic brain. The relative contribution of these processes is determined by several factors, including the severity of injury, neuronal maturity, available trophic support and the concentration of intracellular free Ca^{2+}[11]. In addition to triggering acute excitotoxicity, extracellular glutamate and K^+ diffuse from the infarct core and induce repetitive depolarisation in cells in penumbral regions. These peri-infarct depolarisations contribute to the growth of the infarct lesion[12-14].

Peri-infarct Depolarisation

These are the spontaneous waves that propagate to penumbral region from the core. This is triggered by release of glutamate, K^+, Ca^{+2} during energy depletion. Due to anoxic depolarisation cells present in ischemic core die due to lack of energy. The infarct size increases as the depolarisations increases[6,15].

Inflammation

Increased levels of reactive oxygen species and intracellular Ca^{2+}, as well as hypoxia itself, trigger the expression of pro-inflammatory genes. Consequently, mediators of inflammation are produced by injured brain cells. Inflammatory mediators induce the expression of adhesion molecules, including intercellular adhesion molecule-1, P-selectins and E-selectins, on endothelial cells. Adhesion molecules attract inflammatory cells that cross the vascular wall and enter the brain parenchyma. A myriad of chemokines are produced in the injured brain, guiding the migration of inflammatory cells towards their target. In addition to blood-borne inflammatory cells, microglias from the parenchyma are also activated and participate in the inflammatory response[6].

Apoptosis

It is the form of programmed cell death which involves many signalling pathways and activation of various families of proteases (caspases). Apoptosis is the feature of ischemic penumbra rather than core as the damage is milder in the former. Anything of the following can initiate the apoptosis: Free radicals, death receptor ligation, DNA damage, protease activation and ionic imbalance. Cytochrome c has a pivotal role in the entire cascade of apoptotic events. It initiates formation of apoptosome. Capsase 3 and 7 are the executioners of apoptosis causing dismantling of cell proteins and further DNA damage. Release of Cytc from mitochondria is regulated by Bcl-2 family of proteins. Bax a member of this family (transcriptionally induced by p53) has ability to form pore in mitochondria and release Cyt c. Bak, Bad, Bim, Bid also facilitate pore formation but exact mechanism is unknown. The released Cytochrome c initiates caspase cascade and cause apoptosis by causing DNA damage[16].

Oxidative Stress

Free radicals are generated during ischemia and reperfusion which is responsible for the oxidative stress induced death of cells. Various reactive oxygen species such as O_2^-, OH^-, H_2O_2, NO and $ONOO^-$ are responsible for oxidative

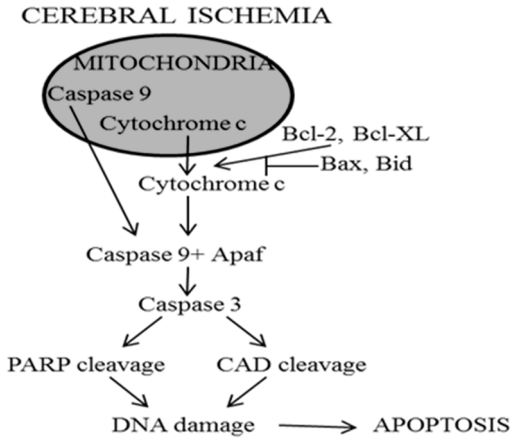

Figure 3: Diagram showing the cascade of apoptosis[16]

stress. Although free radicals are generated in mitochondria from molecular oxygen, they are also generated by over activation of NMDA receptor during cerebral ischemia resulting in increased reactive oxygen species formation. Oxidative metabolism of arachidonic acid also produces reactive oxygen species which cause a lot of damage to cells. These reactive oxygen species causes lipid peroxidation of the cell membranes and thus causes cell death[15].

Ischemia-Reperfusion Injury

When blood supply returns to the tissue after a period of ischemia it results in the damage of the tissue resulting in reperfusion injury. Ischemia-reperfusion injury is characterized by the disruption of blood-brain barrier causing the migration of leukocytes into the surrounding brain tissues which in turn causes the release of various proteases, lipid-derived mediators and reactive oxygen species causing the irreversible damage to the salvageable cells. Due to the disruption of the BBB after IR there is development of cerebral edema and increased intracranial pressure causing the loss of cerebral vasoreactivity resulting in reactive hyperemia. Many factors cause reperfusion injury[17]. Such as, Platelet mediated reperfusion injury, complement mediated reperfusion injury and degradation of membrane phospholipids etc.

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Effect of pre-sowing magnetic treatment on the germination and growth of seeds

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Abstract: The most modern trend of the present agriculture has led to the investigation of environmental friendly techniques. These techniques should have a low environmental impact and the same time to contribute for the increase of yields in crops. Magnetic fields are widely used by many researchers, as they fulfill the requirements of organic agriculture. Different types of magnetic fields have been used in plant experiments, giving some interesting results. Glimpses of findings are discussed here.

Introduction

The most modern trend of the present agriculture has led to the investigation of environmental friendly techniques. These techniques should have a low environmental impact and the same time to contribute for the increase of yields in crops. Magnetic fields are widely used by many researchers, as they fulfill the requirements of organic agriculture. Different types of magnetic fields have been used in plant experiments, giving some interesting results. Agriculture sciences take an interest not only in the common and valued crop -forming factors, but also in those less expensive and generally underestimated, such as ionizing , laser or ultraviolet radiation, and electrical and magnetic fields. From among these the least troublesome and expensive, and at the same time not dangerous to the environment, seems to be bio-stimulation with magnetic field.

Many authors have studied and also reported the effects of static magnetic fields on the metabolism and growth of different plant species. Numerous experiments have been conducted on the effects of magnetic fields on plant growth regarding: ripening of fruits and vegetables; increase in the farm crop; bacteria; virus; behavioral peculiarities of animals, birds, aquatic species, etc. Exposure of seeds to magnetic field for a short time was found to help in accelerated sprouting and growth of the seedlings. Plants also showed deeper roots as well as more vigorous growth compared to those, which have grown out of the untreated seeds. Magnetic field treatment of seeds leads to acceleration of plants growth, proteins biosynthesis and root development. The scientific reports of numerous authors showed that the magnetic field exposure increases germination of non-standard seeds and improves their quality.

Effect of magnetism on monocot plant seeds

Florez studied the effect of the exposure of maize seed to stationary magnetic field on the germination and early growth under laboratory condition[4]. Seeds were exposed to magnetic field strengths of 125 and 250 mT (milli Tesla- a unit of magnetic field strength) for a period of 24 hour. Mean germination time and time required to obtain 10, 25, 50, 75 and 90 per cent of seeds to germinate were calculated. The results showed a reduction in the mean germination time and time required to obtain 10, 25, 50, 75 and 90 per cent of seeds to germinate for most magnetic treatment, therefore their rate of germination was increased. Treated plants grew faster than control plants. The greatest increase was obtained for the plants continuously

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exposed to 125 or 250 mT for 10 days.

Pietruszewski studied the effect of magnetic seed treatment on yield and biological properties of the spring wheat cultivar viz[3]. Henika and Jara. He recorded the positive effect with an alternating magnetic field of 30 to 100mT on yield and also on the albumin, starch and gluten content of the treated seed than the control.

Bhatnagar and Dev conducted an experiment to find out the effect of pregermination exposure of 5 to 6 months old wheat (Cv. Sonalika) seeds having 7.3 per cent moisture content to magnetic field of 500, 1000, 1500, 2000 and 3000 Oersted (a unit of magnetic field strength; 1 mT = 10 Oersted) intensities for 3 hours in each case and after exposure the seeds were stored in paper bags at room temperature to use them for seed testing[2]. They found that pre-germination exposure of wheat seed did not increase the overall germination percentage but significantly increased the rate of germination, shoot and root length in the seedling from the treated seed than the control seedling. Magnetic field of 1500 and 1000 Oersted intensities were more effective and recorded the higher rate of germination (99.80 and 99.50 %), shoot length (16.35 and 15.62 cm) and root length (18.30 and 17.24 cm) respectively. The per cent increase of shoot length over the control increased up to the 8th day and then started declining. In case of root the decline commenced after 4th day.

Pittman studied the physiological and chemical features of magnetically treated winter wheat (Triticum astivum) cultivar Kharkov 22 mc seeds and resulted seedlings and reported that seeds exposed to the magnetic field of approximately 1800 Oersted, for 240 hours at 23^0C respired more slowly, released less heat energy and grew faster during the initial 16 hours than untreated seeds[1]. Further they stated that magnetically treated seeds absorbed more moisture and contained more reducing sugars during the initial 72 hours of growth than untreated seeds. Further they noticed that, addition of oxygen to the seed environment during germination repressed shoot growth and enhanced root growth of magnetically treated seeds and addition of CO_2 suppressed the growth of the shoot and root of treated and untreated seeds equally.

Effect of magnetism on commercial vegetable fruit corps

De Souza studied the effects of extremely low frequency non-uniform magnetic fields on tomato seed germination and early seedling growth[9]. The seeds were exposed to non-uniform magnetic fields (MFs) induced by an electromagnet at 80, 120, 160 and 200mT for 1, 3, 5, 10, 15 and 20 minutes. Under laboratory conditions, various combinations of magnetic field strengths and exposure time significantly improved the seed performance in terms of reduction of time required for first seed to complete germination, time to reach 50 per cent germination, time between 10 and 90 per cent germination with increase in the germination rate and increased germination percentage at 4th and 7th day, seedling root and shoot compared to the untreated control seeds. They stated that pre-sowing magnetic treatment has the potential to enhance tomato seed germination and early seedling growth.

Odhiambo studied the 73 % germination of common bean (*Pheseolus vulgaris*) by exposing the seeds to different static electromagnetic field for different duration of exposures such as 0, 3, 4.5 and 6 hours under laboratory conditions[7]. Germinating seeds were counted after 24 hours and they noticed that at 30mT field for 4.5 hours duration of exposure recorded higher (64%) germination in bean seed and further increase in the duration of exposure to 6 hours reduced the germination to 39 %.

Nimmi and Madhu studied the presowing treatment with weak permanent magnetic field of 62 mT for different times (4, 8, 12 and 24 hours exposure) on germination and growth of chilli seeds (Capsicum annum L.) and further reported that all the exposure periods had a stimulating effect on the first stages of growth of chilli seeds compared to unexposed control[8].

De Souza gave pre-sowing magnetic treatment to tomato (Cv Campbell- 28) seeds by exposing them to full-wave rectified sinusoidal non uniform magnetic fields (MFs) induced by an electromagnet at 100mT for 10 minutes and at 170mT for 3 minutes[6]. They recorded significant increase in leaf area, leaf dry weight and specific leaf area per plant and also the leaf, stem and root relative growth rates of plants derived from magnetically treated seeds were greater than those shown by the control plants in the vegetative stage. In the generative stage, leaf area per plant and relative growth rates of fruits from plants of magnetically exposed seeds were greater than those of the control plant fruits. At fruit maturity stage, all magnetic treatments increased significantly the mean fruit weight, the fruit yield per plant, the fruit yield per area and the equatorial diameter of fruits in comparison with the controls. At the end of the experiment, total dry matter was significantly higher for plants from magnetically treated seeds than that of the controls. A significant delay in the appearance of first symptoms of Gemini virus and early blight and a reduced infection rate of early blight were observed in the plants from seeds exposed to MFs.

Racuciu in order to find out the biological effect of low frequency electromagnetic field in Cucurbita pepo, germinated seed of 9 days old were exposed to chronic magnetic field at different durations viz. 1, 2, 4 and 12 hours[5]. They recorded enhanced Chlorophylls ratio (chlorophyll a / chlorophyll b) with 1, 2 and 4 hours exposure times and the correlation between the total carotene pigment level and the chlorophyll a level. Further they recorded up to 21 per cent increase in the chlorophyll a level in 1 hour exposed plantlets and slight inhibitory influence on the chlorophyll b biosynthesis up to 19 per cent diminution in the 4 hours exposure.

Effect of magnetism on commercial Legume corps

Ananta Vashisth and Shantha Nagarajan exposed seeds of chickpea (Cicer arietinum L.) in batches to static magnetic fields strength of 0 to 250 mT for 1 to 4 hours in steps of 50mT of 1 hour[10]. Results showed that magnetic field application enhanced seed performance in terms of laboratory germination, speed of germination, seedling length and seedling dry weight significantly compared to unexposed control. Among the various combinations of field strength and duration, 50 mT for 2 hours, 100 mT for 1 hour and 150 mT for 2 hours exposures gave best results. Exposure of seeds to these three magnetic fields improved seed coat membrane integrity as it reduced the electrical conductivity of seed leachate. In soil, seeds exposed to these three treatments produced significantly increased seedling dry weights of one month old plants. The root characteristics of the plants showed dramatic increase in root length, root surface area and root volume. So they opined that magnetically treated chickpea seeds may perform better under rain fed (un-irrigated) conditions where there is a restrictive soil moisture regime due to their improved functional root parameters.

Effect of magnetism on parasitic plant seeds

Balouchi and Modarres Sanavy studied the electromagnetic field impact on annual medics and dodder (Cuscuta monogyna) seed germination[11]. They observed that electromagnetic treatment increased germination rate and percentage and shoot length in annual medic species while seedling vigour index and dry mass decreased in Cuscuta

monogyna seeds. Hence they opined that electromagnetic field can be applied in annual medic farms for greater crop growth and to control the important weeds such as Cuscuta monogyna in them.

Effect of magnetism on others plant seeds

Ananta Vashisth and Shantha Nagarajan exposed seeds of sunflower (Helianthus annuus) in batches to static magnetic fields of strength from 0 to 250 mT for 1 hour[12]. They observed that treatment of sunflower seeds in these magnetic fields increased the speed of germination, seedling length and seedling dry-weight under laboratory germination tests. Exposure of seeds to magnetic fields improved seed coat membrane integrity and reduced cellular leakage and electrical conductivity. Of the various treatments 50 and 200 mT for 2 hours yielded the peak performance. Further they found that treated seeds planted in soil resulted in statistically higher seedling dry weight, root length, root surface area and root volume in one month old seedlings. In germinating seeds, enzyme activities of -amylase, dehydrogenase and protease were significantly higher in treated seeds in contrast to controls. So they opined that the higher enzyme activity in magnetic field treated sunflower seeds might have triggered the fast germination and early vigor of seedlings.

Conclusion

The present review suggests the tremendous scope in the field of agriculture to be bio-simulation with magnetic field of different intensity and exposure period to increase the germination as well as growth rate and yield of the various crops. It has also been observed and reported that pre-sowing magnetic treatment are not harmful to crops as well as to environment. The environmental friendly techniques can be utilized for the same purpose. The cultivation of plants under the effect of magnetic effect could be the background of crop improving in the frame of future agricultural techniques. The farmers can take best advantage in terms of quantity and quality of crops by using magnetically treated seeds. It is possible to establish a small working business in pilot scale primarily for providing effective and improved eco-friendly variety of seeds for better agricultural product that may also be useful for further research. In present scenario it is a great opportunity for a researcher to deal with small scale business on the basis of this investigation.

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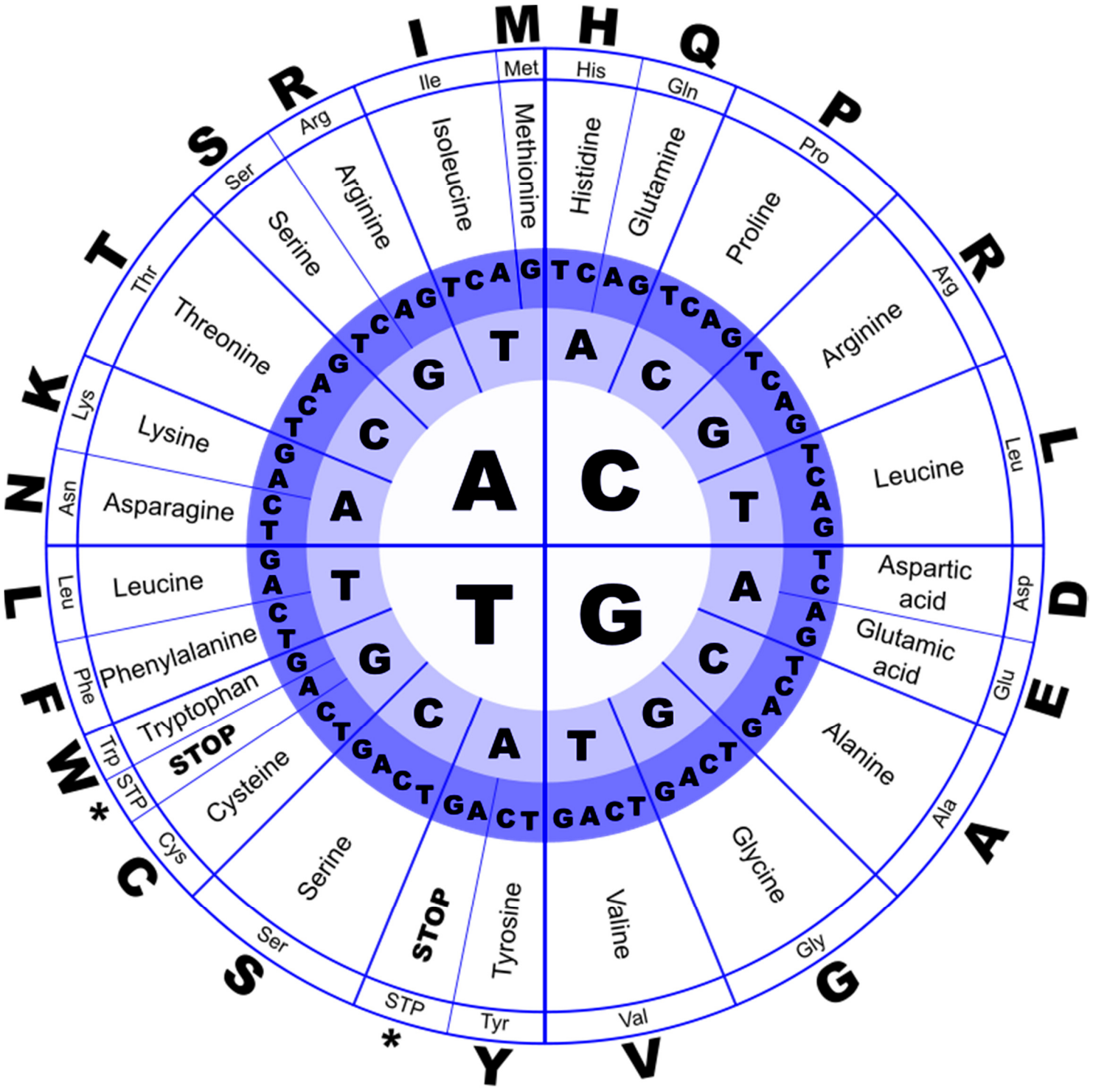
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