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CULTURE-INDEPENDENT TECHNIQUES FOR STUDYING MICROBIAL DIVERSITIES IN THE AQUATIC ENVIRONMENT

Pragati Kumari[1]*, Bhautik D. Savaliya[2] and Vikas Kumar Ujjania[2]

[1]Department of Fisheries Hydrography, College of Fisheries (DBSKKV), Shirgaon, Ratnagiri, Maharashtra (415629), India
[2]ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra(400 061), India
*Corresponding author: pragatik46264@gmail.com

Abstract
We can better comprehend the diversity of microorganisms on earth by employing culture-independent techniques. By eliminating the phase of culture, we can acquire access to previously inaccessible species. Several direct approaches for studying environmental microorganisms based on the direct amplification and analysis of the small subunit ribosomal RNA gene have been developed over the past 20 years. The pool of polymerase chain reaction (PCR) products can be cloned and sequenced or subjected to a growing number of genetic profiling techniques such as amplified ribosomal DNA restriction analysis (ARDRA), terminal restriction fragment length polymorphism (T-RFLP), denaturing gradient gel electrophoresis (DGGE), temperature gradient gel electrophoresis (TGGE), single strand conformation polymorphism (SSCP), automated ribosomal intergenic spacer analysis (ARISA), denaturing high-performance liquid chromatography (DHPLC), fatty acid based methods and metagenomic. The investigation of culture-independent techniques facilitated a greater knowledge of microorganisms under numerous environmental situations. This brief discussion focuses on the diverse recent applications of culture-independent techniques for microbial diversity and community analysis.

Keywords : Culture-independent techniques, molecular analysis, microbial diversity

Introduction

Microorganisms are ubiquitous and they are frequently the first organisms to respond to chemical and physical shifts in their environment. Microbial communities are at the bottom of the food chain, hence changes in them typically indicate environmental health and viability. Microscopic communities are an integral part of the ecosystems in which they are found. Wastewater treatment plants remove nitrogen from the wastewater stream using microbial populations. These communities also remove excess nutrients, phosphorus and carbon from wastewater to clean and purify it for reuse. Soil and sediment microbes have been linked to nutrient cycling, both in naturally occurring ecosystems and in polluted ecosystems where they play a role in bioremediation.

Data gathered from the study of these communities can be utilized for the investigation of both scientific and applied environmental phenomena. Understanding microbial diversity is one of the primary goals of environmental microbiology. To describe the diversity of microbial communities, it is necessary to characterize their individual members. Identifying the microorganisms in a microbial community may reveal how they interact and what metabolic processes are taking place. There is a wide variety of approaches that can be taken to learn more about the microorganisms that live in these areas. These approaches range from cultivation-based, where

samples are diluted and microorganisms are cultivated on growth media, to cultivation-independent, where DNA is extracted and bacteria are recognised by molecular markers.

Culture independent techniques

Culturing has helped us understand specific organisms, yet an artificial homogenous medium only grows a small fraction of organisms, making it difficult to use for community study. Culturing cannot replicate the ecological niches and symbiotic connections found in complex natural ecosystems that maintain microbial diversity. Due to the innate selectivity of each cultivation technique, growth of specific members is augmented, diminished, or even hindered, therefore species number and abundances reported in the lab using cultivation-dependent techniques rarely reflect in situ diversity. Therefore, methods have been developed for determining the diversity of microbes through the use of directly extracted signature molecules, such as fatty acids or DNA.Table 1 showing Culture independent techniques and their applications in microbial diversities of soil, animal and human (Su*et al.,* 2012).

Table 1: Culture independent techniques and their applications in microbial diversities of soil, animal and human (Su*et al.,* 2012)

Sl. No.	Sample	Applications	Culture independent techniques
1.	Soil	Agricultural soils, forest soil, grassland soil and wetland	Cloning and sequencing, Pyrosequencing, RFLP, DGGE
		Soil from cave	RFLP
		Soil from Antarctic	DGGE, RFLP, Cloning and sequencing
		Soil from marine	DGGE, RFLP, Cloning ad sequencing
		Soil from mine sites and hydrocarbon polluted place	Cloning and sequencing, DGGE
2.	Animal	The development and stability of the genus Bacteriodes in the human flora-associated mice	DGGE
		The bacterial diversity of fecal sample from the wild pygmy loris	RFLP
		The bacterial diversity of fecal sample from human-habituated wild chimpanzees	T-RFLP
		Bronchopneumonia in free-ranging bighorn sheep	RFLP
		Biodiversity of larvae and adult midgut microflora	Cloning and sequencing
3.	Human	Bacterial diversity of stomach, throat and fecal samples	Pyrosequencing
		Bacterial diversity of human nostril and oropharynx	Cloning and sequencing

SI. No.	Sample	Applications	Culture independent techniques
		Bacterial diversity of breast milk in women with lactational infectious mastitis	DGGE
		Bacterial diversity of synovial fluid samples of reactive and other forms of arthritis	Cloning and sequencing
		Bacterial diversity of the periodontitis patient's oral cavity	Cloning and sequencing
		The distribution of methanogens in the periodontal and endodontic sample from necrotic teeth	T-RFLP
		The impact of antibiotics on intestinal bacterial	Pyrosequencing, Cloning and sequencing
		The relation between gut microbial ecology neonatal necrotizing enterocolitis	Cloning and sequencing, T-RFLP
		The relation between oral or gut microbiota and atherosclerosis in humans	Pyrosequencing
		The relation between cervicovaginal microbiota and female lower genital tract infections	qPCR, DGGE

PCR based methods

Utilizing 16S rDNA or rRNA is now the most prevalent method for community analysis. The phylogenetic features of 16S and the availability of a large number of sequences provide a substantial advantage. The utilization of other genes, such as the one for the σ factor rpoB, has demonstrated higher levels of discriminating across species for certain groups. Functional genes, such as the nasA gene for nitrate assimilation, the nodD gene for rhizobia communities and the amoA gene for ammonia oxidizers, are also employed in diversification research, particularly when exploring structure–function correlations. In the polymerase chain reaction (PCR), the template for the reaction is the metagenomic DNA that was isolated from the environmental samples. The pool of PCR products can once more be either cloned and sequenced or subjected to a growing number of genetic profiling techniques, such as ARDRA, T-RFLP, DGGE, TGGE, SSCP, ARISA and DHPLC.

Cloning and Sequencing

The initial step toward using sequencing to identify a species is the cloning of PCR-amplified sequences. Some methods of cloning use an overhanging 3'-A that is added to PCR products by Taq polymerase. Due to the "sticky end," ligation into vectors with an overhanging 3'-T is quick and easy. After cloning into vectors, sequencing the inserts provides the highest phylogenetic resolution, allowing species identification or resemblance to recognised species using huge and fast developing sequence databases. Amplified ribosomal DNA restriction analysis (ARDRA) is

utilized to confine sequencing to a specific number of operational taxonomic units, hence reducing the amount of labour required.

Terminal Restriction Fragment Length Polymorphism (T-RFLP)

T-RFLP takes advantage of the high resolution of automated sequencing technologies to determine genetic variation at the terminal restriction site. Marker genes are amplified with PCR by adding a fluorescent dye to the 5' end of one of the primers. This makes the products stand out. PCR products are then restriction-digested with 4-base cutters. Physical separation of the mixture of restricted PCR products is performed using acrylamide sequencing gels or sequencing capillaries. When creating an electropherogram, only the terminal fragments that have been labeled are recognised with a laser. The polymorphism is determined purely by the fragment length. Fragment lengths can be precisely assigned with single base pair resolution using a size standard labeled with a distinct fluorophore.

T-RFLP profiling produces an electropherogram, an intensity depiction of an electrophoresis experiment (gel or capillary). Electropherograms show fragment sizes on the X-axis and fluorescence intensity on the Y-axis. Thus, an electrophoresis gel band becomes a peak on the electropherogram whose integral represents its total fluorescence. T–RFLP profiles assume that each peak represents one genetic variant in the original sample and its height or area represents its relative abundance in the community. Electropherogram data is usually evaluated via pattern comparison or multivariate analysis. Pattern comparison compares the basic forms of electropherograms of different samples for changes like peaks between treatments, relative size, etc. Multivariate analysis typically uses ecological and biodiversity approaches.

Denaturing Gradient Gel Electrophoresis (DGGE) and Temperature Gradient Gel Electrophoresis (TGGE)

DGGE and TGGE separate small PCR products (200–700 bp) on acrylamide gels with a low to high denaturant gradient. One of the primers contains a 5'- GC rich artificial clamp of roughly 40 bp. On agarose or nondenaturing acrylamide gels, DGGE and TGGE PCR fragments are usually the same length. TGGE uses a temperature gradient, while DGGE uses a chemical denaturation gradient. Electrophoresis goes against the denaturing gradient. Products are initially sorted by molecular weight, primarily GC content. PCR products separate double-stranded DNA as they move through the gel under increasing denaturing conditions. The melting behavior mostly depends on the product's length, GC content and nucleotide sequence. To separate strands, the denaturant requirement must be stronger the higher the inherent stability. Electrophoresis mobility is directly affected by molecule shape. At first, the process of melting is only partially complete, with separate domains coming together to form a single strand. This partially denatured DNA migrates more slowly through the gel than the native version. As melting advances, the rate of retardation increases. Strand separation covers the entire length except for a GC-rich clamp. This clamp binds the strands together and melts at a high temperature, creating a "butterfly-shaped" molecule that migrates slowly in the gel. As mentioned above, strand separation can be done using the denaturing chemicals formamide (0–40%) and urea (0–7 M) in DGGE (with a constant gel operating temperature of roughly60 ^{o}C or an appropriate heat gradient in TGGE (which uses no chemical denaturants). For best resolution, gradients may need to be adjusted to the sample. These approaches may be able to detect changes in the melting behavior of smaller DNA fragments that differ by a single base substitution.

The basic idea is to separate the strands of DNA depending on the proportion of CG base pairs to AT base pairs in each strand. The DNA is heated in a polyacrylamide gel with a denaturant gradient. The DNA sample melts at different denaturant concentrations as it moves along the gel. Higher GC content makes melting harder, while lower GC content melts faster. There are many different applications for DGGE, which has led to its widespread adoption. The following are a few examples that can be used to determine the amount of biodiversity present in different settings, such as soil, fresh water, salt water, wastewater or air, detecting mutations and animal husbandry genotyping detection.

Single Strand Conformation Polymorphism (SSCP)

SSCP, an electrophoretic approach used in mutation analysis, can be utilized to analyse microbial populations. This approach of genetic profiling, like DGGE/TGGE, permits the separation of PCR products that are identical in length but have sequence variability. In contrast to DGGE/TGGE, single-stranded DNA is used to separate the samples instead of double-stranded DNA. Denaturing conditions are used to separate the strands, and then the separated molecules are loaded onto a non-denaturing acrylamide gel. Single-stranded DNA folds in nondenaturing circumstances. Intramolecular interactions that change the 3-D conformation are responsible for the structure, which in turn is determined by the nucleotide sequence and the physicochemical setting (e.g. temperature and ionic strength). Even though they have the same molecular weight, these secondary structures identify phylotypes. Different conformations migrate and mobilities in the gel, separating complicated community DNA mixes. A single mutation can change the secondary structure of single-stranded DNA in short PCR products, causing variable migration velocities and gel separation.

Automated Ribosomal Intergenic Spacer Analysis (ARISA)

Compared to surrounding genes, intergenic transcribed spacer (ITS) sections between the 16S and 23S ribosomal genes are more heterogeneous in length and nucleotide sequence. When ribosomal gene sequence fingerprinting is insufficient, both sorts of changes can subtype bacterial strains and closely related species. ARISA uses species-specific amplicon size variation. Fluorescently labeled PCR products are electrophoretically separated and then detected by laser light with high sensitivity on an automated sequencing device to generate a community profile.

Denaturing High-performance Liquid Chromatography (DHPLC)

DHPLC has been used for a variety of purposes, including gene mapping, mutation detection, and clinical isolate identification, but more recently it has also been put to use in the study of ecological communities. Instead of employing an acrylamide matrix, high performance liquid chromatography (HPLC) is used to separate a complex mixture of 16S PCR products. Similar PCR products can be separated by either thermal or chemical denaturation. In an oven-based HPLC cartridge, DNA is injected in a solution comprising triethylammonium acetate (TEAA) and acetonitrile. The positively charged TEA+ with hydrophobic and hydrophilic ends forms when TEAA dissociates in solution. The hydrophobic end connects to the cartridge's hydrophobic beads, while the positive charge establishes ionic connections to double-stranded DNA's negatively charged phosphate backbone. Thus, TEA+ molecules link DNA to cartridge material. DNA binding strength varies on fragment length, content, and position of G and C nucleotides. A rise in temperature and acetonitrile gradient weakens the TEA+ ions' bridging ability, allowing

differential elution of the bound DNA mixture. The PCR products are eluted and sent through a UV detector, which creates an electropherogram by recording the absorbance over time.

Fatty acid-based methods

DNA-based methods have considerable potential; however, they have issues with nucleic acid extraction repeatability and PCR selectivity. Further, genetic research reflects total rather than expressed diversity, and the genetic diversity is so extensive that fine-scale identification of consequences, necessary for routine monitoring and early warning, may be invisible. Phospholipid fatty acid (PLFA) profiles can accurately characterise the numerically dominating fraction of soil microbial communities without cultivating the organisms. The approach determines soil microbial community composition and biomass size in situ. Phospholipids fatty acids (PLFA) are the microbe's "skin" (microbial membrane) and can be used to quantify environmental responses. PLFA analysis extracts "signature" lipid biomarkers from microorganism cell membranes and walls. Lipids are extracted from cells using organic solvents, concentrated, and then examined by gas chromatography–mass spectrometry (GC/MS) to determine their molecular identities. A profile of the PLFA in a sample can characterize the microbial community based on the types and abundances of fatty acids produced by the bacteria present.

Metagenomics

The word "metagenomics" was coined by Jo Handelsman, Jon Clarly and Robert M. Goodman in 1998. Metagenomics refers to the study of microorganisms by means of genomics analysis via direct extraction and cloning of DNA from a collection of microorganisms. Metagenomics studies genetic material from environmental samples such soil, water, and faeces. Metagenomics technology will likely advance medicine, agriculture, energy generation, and bioremediation. For novel molecules with medical and biotechnological applications, metagenomics can help unleash the vast, uncultured microbial diversity already existing in the environment. Metagenomic investigations have found many novel microbial genes coding for energy acquisition, carbon, and nitrogen metabolism in natural conditions previously thought to lack such metabolism.

The first and most important stage in metagenomics is processing the samples. The amount of DNA extracted should be enough to represent all the cells in the sample, and the quality of the nucleic acids should be high enough to use in library construction and sequencing. Check sample fractionation processes for target enrichment and non-target contamination. Biopsies and groundwater frequently give very little DNA, but most sequencing technologies require high amounts of DNA (ng or µg), therefore amplification of starting material may be needed. Single-cell genomics and metagenomics use multiple displacement amplification (MDA) with random hexamers and phage phi29 polymerase to enhance DNA yields.

The application of metagenomics (Fig. 1) can enhance tactics for monitoring the impact of contaminants on ecosystems and decontaminating polluted settings. To succeed, experiments including bioaugmentation or biostimulation require a deeper knowledge. There has been recent success in extracting useful genes, enzymes, and natural compounds from the genomes of non-culturable bacteria. Metagenomics libraries are vital for discovering new enzyme activity and genetic tracking for all future biotechnological applications. Microbial communities are being characterised by metagenomics sequencing. The cultivation-independent study of microbial

populations is allowing researchers to employ functional metagenomics methodologies to learn more about the connections between plants and microorganisms.

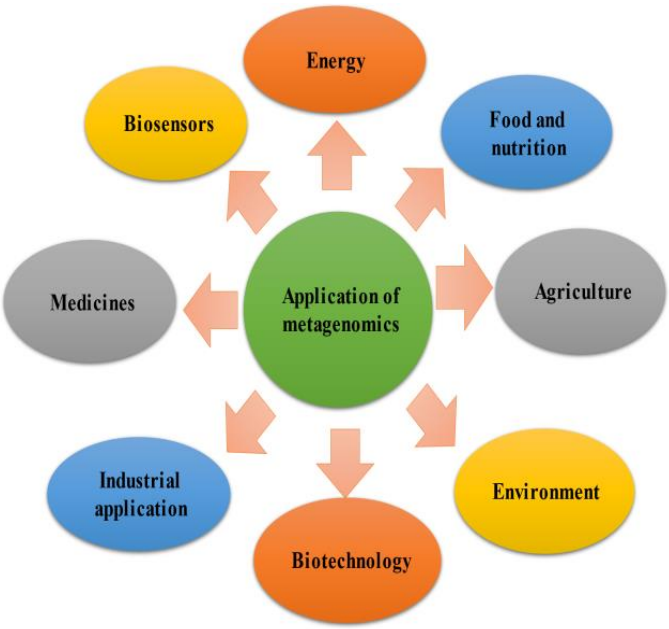

Fig. 1: Application of Metagenomics

Sequence based metagenomics

Studies of metagenomic sequences have been utilized for many purposes, including the comparison of organisms from diverse communities, the assembly of genomes, the identification of genes, and the discovery of full metabolic pathways. Genome assembly necessitates a great deal of computing power, yet it can lead to a greater comprehension of how specific genes aid organisms in surviving in a particular environment. Sequence-based metagenomics can also determine a sample's diversity and number of bacterial species. Microbial diversity analysis is cheaper and faster than genome assembly and can reveal a sample's bacterial ecology.

16s-rRNA sequence

The 16S rRNA in a typical prokaryotic cell contains around 1,542 nucleotides and serves as a portion of the ribosomal RNA. The 16S gene contains regions that are largely conserved throughout species as well as regions that are variable and species-specific. Amplification targets are conserved regions. Variable regions help classify organisms. This sophisticated tool is used for classification and genomic analysis. The application of 16S rRNA gene sequencing has been established as the "gold standard" for bacterial species identification and taxonomic classification. Comparing the bacterial 16S rRNA sequencing helps identify novel diseases like Mycobacterium species. Bacterial identification uses species-specific signature sequences from 16S rRNA gene sequences' hyper variable areas. 16S rRNA sequencing replaces phenotypic methods of bacterial identification in medical microbiology. It can also categorise bacteria into new genera or species. New species that have never been grown can be described using sequencing.

Pyrosequencing

The emission of pyrophosphate initiates a chain reaction that can be detected optically through a process called pyrosequencing. In 1993, BertilPettersson, Mathias Uhlen and Pal Nyren originally

developed the principle of Pyrosequencing by combining the solid phase sequencing method employing streptavidin coated magnetic beads with recombinant DNA polymerase lacking 3'to 5 exonuclease activity (proof-reading), and luminescence detection employing the firefly luciferase enzyme.

Conclusion

Different insights on the microbiological world have been gained by the widespread use of culture-independent techniques in phylogenetic, ecological, diagnostic, and environmental studies in the field of microbiology. Culture-independent methods will improve our understanding of human microbiomes and their role in health, including identifying new treatment targets. Over the past 20 years, culture-independent methods including DGGE/TGGE, SSCP, and RFLP have been widely employed to research microbial communities in different contexts. Due to the potential for bias when employing a single methodology, it is recommended that two or more culture-independent methods be employed to assess the microbial communities in samples. New approaches with higher levels of automation, more sensitivity, lower prices, and increased information provision are anticipated to be developed in the future, and there will be greater uptake of culture-independent methods in environmental ecology. Traditional microbiology will improve when we identify previously uncultivated bacteria and develop a "smarter" medium to accommodate them.

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KALMEGH : A SUPERNATURAL MEDICINAL PLANT FOR HUMAN LIFE

Rimlee Das[1] and Dinesh Rai[2]

[1]PG Scholar, Department of Plant Pathology
[2]Assistant Professor, Department of Plant Pathology
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar (848125), India
Corresponding Author: rimlee783124@gmail.com

Introduction

With the WHO naming coronavirus a global pandemic on 11th March, 2020, it raised the concern over the efficacy of alternative system of medicines i.e., on medicinal herb formulations in preventing and treating various diseases. Among many other medicinal plants such as Giloy, Ashwagandha, Tulsi, etc. Kalmegh is one such herb which has beenused in ancient oriental and ayurvedic medicine for its immunopotenting ability against regular illness. Kalmegh is ranked 17th out of 32 prioritised medicinal plant lists presented by the Indian National Medicinal Plants Board. It plays a significant role in 26 ayurvedic formulas and holds a significant place in the Indian pharmacopoeia. Medicinal properties of *A. paniculata* have also been highlighted by WHO in its 2002 monograph.

Kalmegh

Kalmegh (*Andrographispaniculata* Nees.) belonging to the family Acanthaceae is one of the nineteen species of the genus *Andrographis* indigenous to India and has been used in Indian systems of medicine since time immemorial. Commonly known as “King of Bitters” or “Bhuineem” as it looks very similar to neem and though smaller, has a bitter taste. It is found in Sri Lanka, Pakistan, Java, Malaysia, Indonesia and throughout India. In India, it is cultivated in Uttar Pradesh, Himachal Pradesh, Assam, Bihar, Madhya Pradesh, Tamil Nadu, Karnataka and Kerala. The fresh and dried leaves of kalmegh and juice extracted from the herb are official drugs in Indian pharmacopoeia. Brimming with antioxidants, it is used as a wonder drug in tribal medicine and in Indian Siddha, Ayurvedic systems of medicine.

Cultivation practices of Kalmegh

- It may be grown on a wide range of soils with moderate fertility, from loam to lateritic or gloomy wastelands.
- For the plant to flourish, it needs hot, humid weather with lots of sunlight. The plant grows lushly with the arrival of the monsoon and starts to bloom in September, when the temperature starts to regulate.
- Early in September, seeds are sown in rows with a 5 cm spacing in a nursery that has been prepared with a 1:1:1 ratio of soil, sand, and organic matter. Germination takes 8–10 days.

- When seedlings are six weeks old, they are planted in the field at 30x15 cm or 15x15 cm spacing
- The seed rate for a directly planted crop is 1.5 kg/ha and it is dispersed thinly.
- During the crop season, two to three weeding are required, at 20 days and 60 days after transplantation.
- The crop matures after 120 days of sowing and is ready to harvest. The plants should be uprooted at this point. A small number of healthy plants, on the other hand, should be left in the field for seed production.
- A well-maintained crop grown during monsoon season yields (whole pant) 2.5 tons per hectare should be recorded. It has sizeable demand and yields a reasonable profit to the growers.

Medicinal uses and properties of Kalmegh

Consuming Kalmegh extracts is simply a hack to maintain health and to ward off seasonal disease. It has the following medicinal properties:

1. **Anti-microbial properties:** When andrographolides, aqueous extract, and arabinogalactan proteins isolated from the dried herb of Kalmegh were tested for anti-microbial activity, it was discovered that the latter two had antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas aeruginosa*, while the former was only effective against *B. subtilis*.
2. **Anti-malarial properties:** Kalmegh extract contains an antimalarial compound that has been shown to be active against *Plasmodium berghei* (malaria-transmitting parasite). Its effects were discovered to be even more effective than those of a malaria medicine. It might prevent the spread of the parasite that spreads malaria, making it more efficient.
3. **Rich in anti-oxidants:** It is packed with polyphenols and antioxidants that could aid in the battle against the body's dangerous free radicals. This appears to shield the body cells from dangerous germs and viruses in turn.
4. **Hepato-protective properties**: By generating a cleansing solvent and preventing the generation of free radicals, which damage the cellular membranes that surround liver cells, kalmegh may be useful against liver toxicity. Liver cirrhosis may be brought on by free radicals. Further consequences of this include coma and death. Kalmegh may be a useful treatment for infective hepatitis, according to studies. A study found that a decoction made from the kalmegh plant has cleaning and purifying properties, particularly for blood. It can therefore be used to treat jaundice. The herb kalmegh can help treat fatty liver and lower the risk of gallstone development. It may therefore facilitate the digestion of fat.
5. **Anti-inflamatory properties:** It was found to inhibit oedema. It may also be used to treat renal inflammation brought on by a local bacterial infection as well as chronic inflammation of the colon.
6. **Anti-diabetic properties**: For diabetics, kalmegh may be advantageous since it effectively lowers blood sugar levels by boosting insulin secretion and helps prevent hypoglycemia.
7. **Antithrombotic properties and cardiovascular activity**: According to studies, kalmegh may lengthen the time it takes for blood to clot, decreasing the risk of restenosis—the blood vessel closure that occurs after angioplasty. Utilizing kalmegh can also dramatically lessen blood vessel constriction brought on by dietary cholesterol excess or damage to the inner

lining of blood vessels. Heart tissues may die if their blood supply and oxygen availability are reduced. Studies have shown that kalmegh stimulates the body's natural fibrinolysis mechanism, which dissolves blood clots.

8. **Aids in Digestion:** Due to its laxative qualities, kalmegh aids in the removal of faeces, which helps to improve digestion. It also has choleretic properties, which aid in enhancing bile's qualities and significantly enhance bile flow, aiding in digestion.
9. **Immunity building properties:** Andrographolides can enhance immune system functions such as production of white blood cells which are scavengers of bacteria and other foreign matter, release of interferon, and activity of the lymph system. According to a study conducted on mice, *Andrographispaniculata* is a strong activator of the immune system in two ways

   (1) Antigen-specific response: antibodies are created to combat invasive microbes, and (2) Nonspecific immune response: Invaders are scavenged and destroyed by macrophage cells.

   It stirs up both reactions, making it potent against a range of infectious and cancerous agents.
10. **Acts as painkiller as it is analgesic**: Kalmegh may have painkiller properties in addition to reducing swelling and blood loss.
11. **Can kill cancer cells:** The herb kalmegh is thought to have a cancerolytic effect. Kalmegh has the potential to be effective against a wide range of infectious and cancer-causing substances since it induces dual responses, according to studies. Kalmegh is classified as a cytotoxic agent by the National Cancer Institute because of this potential. It might also be less hazardous than the majority of chemotherapy drugs.
12. **Eliminates mucus from respiratory tract:** It contains immunomodulatory, anti-inflammatory, and antibacterial effects. It might prevent nasal mucous membrane inflammation. Additionally, it might lessen nasal secretions. According to Ayurveda, Kalmegh's ability to balance Kapha and Pitta makes it effective in the fight against upper respiratory infections, common cold, and flu.
13. **Anti-viral properties:** It has been discovered that kalmegh inhibits interference with the cell cycle. Such interference is the cause of viral infections like HIV-1. Interferon, a cytokine produced by cells in reaction to viruses, is released by Kalmegh. It has strong antiviral and antiproliferative properties (stops the growth of viruses).
14. **Increases white cell phagocytosis, improves T-lymphocyte counts.**
15. **Can be used as a sedative:** This herb produces an adequate and long-lasting anaesthesia that engages the brain's barbital receptors.
16. **Anti-helminthic properties:** The herb kalmegh aids in killing of intestinal worms and promotes intestinal health.
17. **Anti-fertility properties:** Ovulation is prevented by kalmegh. The production of human progesterone, which is necessary for a healthy pregnancy, is effectively inhibited by Kalmegh. It is used as a contraceptive method.
18. **Treats Filaria**: Extracts from kalmegh may be useful for treating filaria, a condition in which a lymphatic channel obstruction causes a noticeable swelling known as elephantiasis.
19. **Can fight against snake venom:** Used as an antidote against snake and insect bite.

20. **Anti-pyretic properties**: reduces fever both in humans and animals, caused by multiple infections or by toxins

KalmeghBoti
Source: Bengali Food and Stories, Barnali Dutta, 2013

It is widely used in Indian systems of medicine in the treatment of many diseases such as ulcer, diabetes, high blood pressure, chronic malaria, skin disease, flatulence, influenza, cervical erosion, pelvic infection, chickenpox, mumps, burns. leprosy, bronchitis, dysentery, dyspepsia, cancer and HIV infections. Kalmegh forms the principle ingredient of a house hold medicine called `Alui', extensively used in West Bengal for general debility and certain forms of dyspepsia amongst adults and infants. In Traditional Chinese Medicine, *A. paniculata* is regarded as a bitter and cold property herb used to treat hot conditions such as acute infections and fever, including throat infection, pneumonia, tonsillitis, dysentery, gastroenteritis and pyelonephritis. The hot water extract of the whole plant is used for acute jaundice where the powder is mixed with garlic and given orally with butter milk for four days and also as febrifuge while the extract of dried leaf is used to treat stomach worms and the fresh leaf juice along with the leaf juice of *Azadirachtaindica* and *Tinosporacordifolia* are taken to cure cholera. Kidney and retina related problems can be cured by the magic of Kalmegh. It is used in Malaysian folk medicine for treating diabetes and hypertension. Scientists today, however, are focusing on the herb's application in treating the 'killer' diseases that blight modern life, such as heart disease, cancer and even AIDS. It has been widely used in Chinese medicine as an anti-inflammatory and antipyretic drug for the treatment of cold, fever and laryngitis. The plant is also one of the components of NilavembuKudineer Chooranam, a poly herbal Siddha preparation containing equal proportion of nine plants used in the prevention and treatment of dengue viral fever and COVID-19 in human and hence approved for use by Government of India.

Medicinal constituents:

1. **Terpenoids:** The entire herb is a source of various diterpenoid compounds, the most important of which is andrographolide, which is a 'diterpene lactone' water soluble substance. It is dispersed in various ratios throughout the entire plant body. The amount of andrographolide in the stem is less (2.0%) than that in the leaves, which have the highest concentration (2.5%). Andrographolide is a colourless, crystalline substance with an extremely bitter taste. Deoxyandrographolide and neoandrographolide are two more dominant diterpenoids that have mostly been isolated from the aerial sections of A. paniculata in addition to andrographolide.
2. **Flavonoids:** Besides andrographolides, the plant also contains flavonoids, Cinnamic acid, caffeic acid, ferulic acid and chlorogenic acid.
3. **Misscellaneous:** Particularly from the roots of *A. paniculata*, a number of diverse chemicals have been identified. Using a combination of thin layer and column chromatography, four xanthones were isolated from the roots. Its roots are used in Japan to extract a variety of flavonoids, including andrographidin A, B, C, D, E, and F, whose quantity ranges from 0.015 to 0.15 percent. Arabinogalactan proteins were also isolated

from the dried herbs. The roots' trace elements (Cr, Mn, Co, Ni, Zn, Cu, Se, Rb, Sr, and Pb) and macroelements (potassium and calcium) have been identified and quantified.

How to Use Kalmegh ?

Leaves, stem and roots of kalmegh plant harbour active pharmacological compounds which can be used by the following methods.

- Fresh and dried leaves, and juice of the plant used as an official drug.
- Traditionally, garlic added to kalmegh leaf powder with buttermilk for treating jaundice.
- The paste formed by leaves and fresh twigs of the plant.
- Boiling the leaves with water is good for treating stomach infections.

Before taking any herbal supplements, it is however advised to always consult a doctor.

Dried herb

Side Effects of Kalmegh

Like all natural things, Kalmegh abides by the Earth's and its surroundings' inherent balance. Anything consumed in excess is bad, and kalmegh is no exception. Overusing kalmegh may result in negative side effects such.

- May lead to lethargy and decreased activity
- Allergic reactions ranging from mild skin rashes to the potentially fatal condition known as anaphylaxis
- Loss of appetite
- Swollen lymph glands
- Elevations of liver enzymes
- Nausea problems
- It shows an antifertility effect as it prevents ovulation and reduces sperm count.

Precautions to take

- **Pregnancy issues**: Pregnant women shouldn't use it since it has pregnancy-terminating effects that could end the pregnancy. There is no clear information provided regarding whether it can be used when nursing.
- **Children:** It can be consumed orally by kids. However, sometimes it increases immune system activity, which ultimately leads to auto immunological illness.
- **Slow Blood clotting**: It can slow blood clotting and raise the possibility of significant bleeding. Therefore, it should not be used on patients with bleeding disorders.
- **Lower Blood Pressure**: This medicine can lower blood pressure levels, and people already have low blood pressure should avoid this.

Conclusion

We are all aware that this pandemic has put medical science in a precarious position and has put doctors and biologists under pressure to find treatments and vaccinations as soon as possible for the benefit of humanity. In order to find novel treatments that can heal a person of any fatal condition, we should engage more with our natural plants, like kalmegh. Unexpectedly, its pace of cultivation is also rising to meet the need. The incredible advantages of kalmegh have made its

bitter flavour sweeter! We have an ally to help us preserve our health throughout the season, whether we decide to take kalmegh as a supplement or on its own.

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WAYS TO IMPROVE THE UTILIZATION OF DE-OILED RICE BRAN (DORB) IN FISH FEED

Priyanka Verma[1], Devarshi Ranjan[2*] and Mayank Bhushan Singh[3]

[1]Department of Fisheries Resource Management,
Dr. Rajendra Prasad Central Agricultural University,
Pusa, Samastipur, Bihar-848125
[2]Department of Aquaculture,
Dr. Rajendra Prasad Central Agricultural University,
Pusa, Samastipur, Bihar- 848125
[3]Department of Aquaculture,
Acharya Narendra Deva University of Agriculture and Technology,
Kumarganj, Ayodhya, Uttar Pradesh- 224229
*Corresponding author: devarshiranjan508@gmail.com

Abstract
DORB is an agricultural residue in rice mill industries. It is obtained after extracting oil from rice bran. Rice bran contains about 14-18% oil. Due to the presence of oil, rice bran spoils after a few days, so to keep rice bran for a long time, it is very necessary to extract its oil from it. Rice bran after oil extraction is called DORB which does not spoil for a long time. Due to its cheap price it is used as a feed ingredient in cattle, poultry and fish feed. DORB contains proteins, amino acids and vitamins as well as high fiber, anti-nutrients and non-starch polysaccharides. High fiber, anti-nutrients and non-starch polysaccharides lead to poor utilization of DORB, resulting in high feed conversion ratio (FCR) in fish. Therefore, the present article is based on ways to improve the utilization of de-oiled rice bran (DORB) in fish feed.

Keywords : Rice bran, DORB(De-oiled rice bran), anti-nutritional factors, fermentation, and enzymes

Introduction

Over the past ten years, the aquaculture industry in India has steadily grown at an annual rate of 8% (DOF GOI, 2020). Carp culture accounts for over 82% of the nation's production, and about 97% of carp feeds used by Indian farmers are farm-made (Ramkrishna *et al.,* 2013). The most crucial element needed for faster growth and a better production of farmed fish is feeding. Oil cake is the primary conventional source of protein, while de-oiled rice bran (DORB) serves as an energy source for the Asian subcontinent's carp culture. In practice, the most widely utilized feed component for carp production is DORB (De-Oiled Rice Bran). DORB is utilized in carp culture either as mash feed or combination with mash and pelleted feed. DORB, which is fat-free rice bran or rice polish, can effectively substitute other aquafeed products with low protein content (20%) as a source of energy (Limbu*et al.,* 2016). Higher DORB levels in aquafeed can significantly lower the cost of aquafeed. However, it has been noted in recent times that the cost of DORB has significantly grown. Phytates, trypsin inhibitors, oxalates, saponins, tannins, and alkaloids are a few anti-nutritional components that are present in the DORB that limit their use in rations for monogastric animals. The bioavailability of minerals may be impacted by the high anti- nutritional

factors (20 to 70 g/kg phytates) in rice bran (Warren and Farrell, 1991). According to Nwokoto and Bragg (1977), consuming a diet high in fibre can reduce the availability of various minerals, including Ca, Cu, Mg, Mn, P, and Zn. Therefore, by eliminating these anti-nutritional factors, we can increase its utilization in fish feed, because we cannot increase its production due to limited amount of land and water.

Rice bran Vs. DORB

Rice bran (RB) is a by-product of rice milling industry which converts into DORB when its oil content extracted in oil industry. Its composition varies according to the type of milling but it contains 15-22% oil, 11-17% protein, 6-14% fibre, 10-15% moisture and 8-17% ash (Sharif *et al.,* 2014). It is an abundant source of antioxidant compounds such as tocopherols, γ-oryzanol and other phenolics (Aguilar-Garcia *et al.,* 2007), which helps in health benefits including lowering blood cholesterol, decreasing platelet aggregation and anti-inflammation (Lai *et al.,* 2009). It is a good source of lysine and methionine (Dale and Batal, 1997). As such RB is considered a suitable feed ingredient for livestock and fish farming. During oil extraction chemical and heat treatments has given to RB, which may change the quality of the nutrients presence in the bran. On other hand, some nutrient profile would proportionately be higher in the DORB than RB due to oil extraction from RB. Other benefits include less susceptibility of DORB to the rancidity.

Economic importance

- Price of DORB is lower than rice bran.
- It contains more crude protein than rice bran.
- Does not spoil for a long time.
- Has high vitamin B content.
- Has a noticeable softening action on animal body fat.
- It is a good feed for sensitive species and certain animal groups as it is free from gluten and other allergic substances.

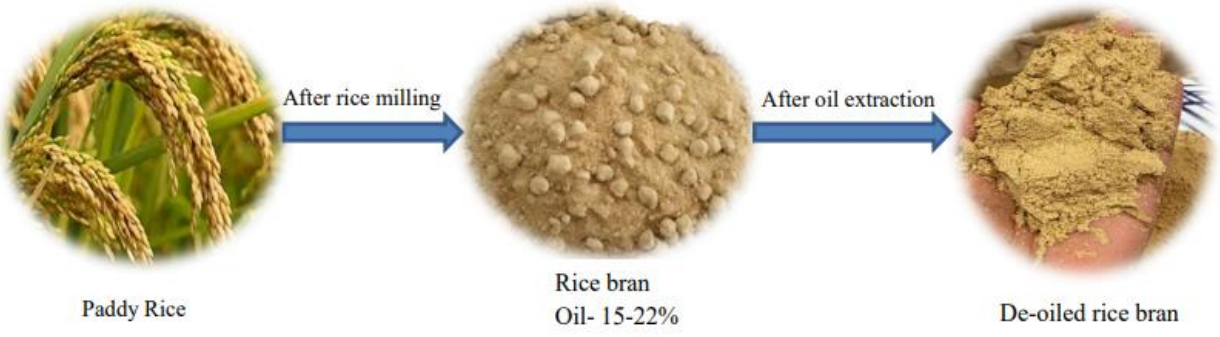

Figure 1. Making process of DORB

Table 1.Nutrient composition of rice bran and de-oiled rice bran

Proximate composition (%)	DORB	Rice bran
Dry matter	89.00	90.00
Crude protein	17.85	14.61

Crude fibre	14.80	11.05
Ether extract	1.60	17.20
Ash	14.30	9.90
Nitrogen free extract	51.45	47.24

Source: Islam et al. (2018)

Ways to improve the utilization of DORB

1. Solid state fermentation

The nutritional value of agro-industrial materials that can be employed in the animal and aqua-feed industries have reportedly been improved by Solid state fermentation (SSF) (Pandey*et al.,* 2000). SSF technology also helps in increasing the protein quality and nutrient digestibility. This technique has proved to be very helpful and ideal in increasing the levels of nutrients and their bioavailability. Hazardous nutrients can be eliminated or reduced by using microorganisms with SSF technology. The USFDA has generally recognized as safe *Rhizopusoryzae*, a fast-growing fungus that reproduces by means of hydrophobic sporangiospores that expand rapidly after maturation. Therefore *Rhizopusoryzae* is usually chosen to ferment DORB. It is clear from the above explanation that SSF technology is very efficient and economically viable method in enhancing the nutrient profile and reducing toxic anti-nutrients present in DORB.

2. Exogenous enzyme supplementation

The majority of the ANFs in DORB are protein-based and heat-labile (Juliano, 1985) except for phytate. The non-starch polysaccharide (NSP) content of DORB is likewise relatively high, with arabinose and xylose predominating (Annison *et al.,* 1995). Many plant materials contain phytic acid, an ANF that chelates with different macro- and micronutrients and impairs the digestion of those nutrients. In various fish species, dietary microbial phytase supplementation has been found to be very promising for reducing the harmful effects of phytate and improving the fish's ability to absorb nutrients and thrive. Fish lack the NSP digestion enzymes; hence non-starch polysaccharide (NSP) is regarded as an unusable energy source for them. By interfering with digestion and absorption, NSP lowers the energy concentration of the feeds and decreases the digestibility/bioavailability of nutrients. Additionally, NSP obstructs the ability of digestive enzymes to reach their substrates. The addition of dietary NSPase to plant-based feedstocks enhances nutrient utilization and lowers faecal waste discharge into the environment. It has been demonstrated that NSPase improves fish growth performance, feed conversion, and protein utilization efficiency. Exogenous non-starch polysaccharidases (NSPase) may have advantageous effects due to the hydroxylation of NSP, which enhances carbohydrate digestibility, or because it enhances the digestibility of other nutrients. As was mentioned above, DORB contains a number of ANFs and NSPs that prevent rice bran from being utilized as a source of nutrients. Thus enzyme supplementation is crucial to increasing the use of DORB in fish diet.

3. Supplementation of deficient nutrient

It is well known that plant-based components always contain some anti-nutritional factors (ANFs) and typically lack several crucial amino acids and fatty acid. High levels of plant proteins in aqua-feed lead to an imbalance in essential amino acids, which impairs growth, reduces feed consumption, and raises feeding costs. According to reports, adding extra amino acids and fatty acids to fish diet can help them grow and stay healthy. Lysine and methionine supplements

dramatically increased the growth rate, feed effectiveness, and protein digestibility of fish fed a plant-based diet. Ranjan*et al.,* (2018) found that adding L-lysine at a rate of 1.4% and L-methionine at a rate of 0.4% in DORB based diet greatly improved *Labeorohita* growth performance. In order to increase the use of the DORB-based diet, it may be effective to supplement any essential amino acids that are low in it. The marginal farmers who only utilize DORB to feed carps will find this method to be of great benefit. According to reports, growth of fishes can be enhanced by adding n-3 fatty acids (EPA and DHA at a rate of 0.5%) in a diet based on DORB. Eicosapentaenoic acid (EPA, 20:5n-3), docosahexaenoic acid (DHA, 22-6n-3), and other important fatty acids are needed to enhance fish growth, immunity, and stress tolerance (Tocher, 2003).

Conclusion

De-oiled rice bran (DORB) is an agro-industrial residue, which is most commonly used ingredient in the diets of cattle, poultry and fish. Along with this, they are also used in making fiber-rich biscuits and extraction of an antioxidant compound like oryzanol and other industrial uses. Due to the increased competition, there will be a huge imbalance in the demand and supply for this ingredient in the years to come. DORB is associated with high fiber content, anti-nutrients, and non-starch polysaccharides which lead to its poor utilization resulting in a higher feed conversion ratio (FCR) in fish. Therefore, some strategies such as solid-state fermentation, exogenous enzyme supplementation, and supplementation of missing nutrients such as amino acids and fatty acids have to be used to increase the utility of this element.

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SULPHUR : A NECESSITY NUTRIENT FOR OILSEED CROPS

Leishangthem Momo Singh
Department of Agricultural Chemistry and Soil Science,
SASRD, Nagaland University, Medziphema, Nagaland -797106
Corresponding author: momoleishangthem1@gmail.com

Abstract
The country's diverse agro-ecological conditions are ideal for growing annual oilseed crops. Sulphur, the "yield + quality nutrient," improves crop quality in a variety of ways, including increasing seed oil content and increasing protein percentages in plants and harvested produce. Sulphur can be applied to the soil via any suitable S-carrier, with the choice based on crop, local availability, price, and the need for other nutrients. Identification of S-deficient areas and development of appropriate strategies to increase S fertiliser production and distribution to ensure that S-containing fertilisers are available at the retail level when farmers require them in order to increase the production of high-quality oilseeds.

Introduction
Despite being the world's fifth largest oilseed crop producer, India is one of the world's largest importers of vegetable oils today. Oilseeds are grown on 270.4 lakh hectares in India, with a total production of 33.4 million tonnes (GoI, 2021). Gujarat is the third largest producer of oilseeds in India, after Madhya Pradesh and Rajasthan, and includes seven edible oilseeds (groundnut, rapeseed & mustard, soybean, sunflower, sesame, safflower, and niger) and two non-edible oilseeds (castor and linseed). Almost 72% of the oilseeds area is restricted to rainfed farming by small farmers, resulting in low productivity. However, a breakthrough in oilseed production was achieved by introducing cutting-edge crop production technologies. Sulphur is important in the nutrition of oil seed crops because it is the constituent of amino acids such as cystine, cysteine, and methionine. Sulphur (S), along with nitrogen (N), phosphorus (P), and potassium (K), is now recognised as the fourth major plant nutrient, and ranks 13th in terms of abundance in the earth's crust. With each passing year, sulphur deficiency becomes more severe, severely limiting crop yield, produce quality, nutrient use efficiency, and economic returns on millions of farms.

Functions of sulphur in plants
One of the 17 important plant nutrients is sulphur. It is absolutely necessary for the growth and development of all crops. The majority of a plant's S needs are taken through the roots as sulphate (SO_4^{-2}) (Singh *et al*., 2013).

1. Sulphur is vital to the development of chlorophyll, the green material in plants that allows photosynthesis. Photosynthesis allows plants to synthesize starch, sugars, oils, lipids, vitamins, and other essential substances.
2. It enhances protein creation because S is found in three s-containing amino acids (cysteine, cystine, and methionine), which are the building blocks of protein. These amino acids contain approximately 90% of the plant S.

3. Sulphur is a component in the synthesis of oils. This is why enough sulphur is so important for oilseeds and enzyme activation, which facilitates in biochemical activities within the plant.
4. It boosts crop yields and enhances produce quality, which both influence the market price a farmer receives for the produce. S increases crop quality by increasing protein and oil percentage in seeds, cereal quality for milling and baking, and marketability.

Sulphur deficiency symptoms in oilseed crops

As the S status of growing plants falls below the threshold level, visible symptoms of S deficiency occur on the plant. Sulphur deficiency symptoms are similar to those of nitrogen deficiency in that the leaves turn pale-yellow or light green. Unlike N, symptoms of S insufficiency develop initially on the younger leaves and persist even after N treatment.

Table 1: Critical levels of S in plants

	% S concentration in dry matter		
Crop	**Deficient**	**Moderately Sufficient**	**Sufficient**
Groundnut, Mustard, Soybean	0.10-0.25	0.25-0.40	above 0.40
Sunflower, Linseed	0.25-0.35	0.35-0.55	above 0.55

Source: Singh (2006)

Groundnut: Juvenile plants are smaller, paler, and more erect from the petiole, giving the trifoliate leaves a "V" shape. Older leaves may still be green. The area around the main vein in young leaves may be pale. Nodulation and pod development are reduced, and seed maturity is delayed.

Linseed: There is yellowing, curling, and premature drying of the tips of immature terminal leaves. Chlorosis spreads gradually on old leaves. The stem stays thin and unbranched. The number of flower buds is decreasing, and the majority of them do not open.

Rapeseed Mustard: Cupped leaves and a reddening of the underside of the leaves and stem. Premature flowering results in inadequate pod development. Sulphur shortage affects the oil content of seeds, lowering the economic yield. This applies to all oil crops.

Sesame: Growth is halted, leaves are smaller, and fully emerging leaves are pale at first, then golden yellow. The number of flowers and pods is reduced, and therefore the yield.

Soybean: Fresh leaves are still pale-yellowish green. The size of the leaves and the length of the internodes are both reduced. Chlorosis begins at the leaf margins and spreads inward. In severe cases, the entire plant may turn yellow, resulting in early leaf fall, decreased flowering and fruiting.

Sunflower: The leaves and the inflorescence turn pallid. Plants are noticeably smaller and have shorter internodes. The size of the leaves remains tiny.

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Rapeseed-Mustard


Sesame


Sunflower


Groundnut


Soybean

Fig.1: Symptoms of Sulphur deficiency in plants

Sulphur containing fertilizers

Sulphur can be given to the soil via any viable S-carrier, with the choice based on crop, local availability, price, and the need for additional nutrients. Except for elemental S and pyrites, all sources of S contain S in the water-soluble, plant-available sulphate form (SO_4^{-2}). Soil microorganisms convert the elemental S to the sulphate form in the soil. Because this process takes time, such sources should be supplied 3-4 weeks before sowing so that the sulphate is available when crop demand for S rises. Elemental S particle size is also essential. Smaller particle-sized materials have a larger surface area, which facilitates oxidation to sulphate. Granular forms of elemental S are available that contain varying components of dispersion and thus have improved oxidation rate. Sulphur containing ferrtilizers are Ammonium Sulphate (AS), Single Superphosphate (SSP), Potassium Sulphate (SOP), Ammonium Phosphate Sulphate (APS), Gypsum /Phosphogypsum, Elemental Sulphur products (S bentoniteetc), Zinc Sulphate, S-fortified Ammonium Phosphate etc.

Modes of S application

The main techniques of applying sulphur fertilisers in soils are broadcast or dribble banded, broadcast and subsequent incorporation, band placement, seed placement, and banded near the seed. Broadcasting and band placement strategies are two of the most used. The 4R nutrient stewardship principle (Right Source of Nutrient administered at the Right Rate, Right Time, and Right Place) is a current method for improving the efficiency of S-fertilizer use. To avoid the loss of the nutritional element S, scientific management measures might be implemented. In the past, such recommendations received less attention because a fair amount of S was added through AS, SSP, APS and gypsum etc. For most field conditions, 20-50 kg S ha^{-1} is suggested for oilseed crops (Shah *et al*., 2022).

Management aspects of sulphur containing fertilizer

The government and industry should take note of the districts identified as S deficient and implement appropriate measures to increase S fertiliser production and distribution to ensure

that S containing Fertilizers are available at the point of purchase when farmers require them. Fertilizer statistics at the national and regional levels should begin reporting S data on a regular basis, in addition to NPK. Extension staff and trainers play an important role in educating farmers about the importance of incorporating S in balanced fertilisation. Times change, and so do nutrient requirements and balancing components in intensive farming. It would be impossible to anticipate large yields from NPK alone, even when applied at optimal rates and in balanced ratios, if S is not applied and the S deficiency is not addressed. A crop cannot provide large yields if three tyres (NPK) are in good form but the fourth (S) is flat, just as a car cannot operate on a flat tyre. As a result, in order to grow more, employ four strategies (NPKS).

Table 2: Management aspects of sulphur containing fertilizer

Fertilizer	Management aspects
Ammonium Sulphate	Integrated N+S application, particularly suitable for top dressing to correct S-deficiency.
Single Superphosphate	Integrated P+S application for basal dose. Also for groundnut where Ca is needed for pod formation.
Potassium Sulphate	Integrated K+S application where crops are sensitive to Cl.
Ammonium Phosphate Sulphate	Integrated N+P+S application as basal.
Elemental S Products	Particularly suitable for fine-textured calcareous soils. Application 3-4 weeks before planting in moist and aerated soil.
Gypsum	Suitable as source of S, particularly for crops which also need high Ca (Groundnut)

Conclusion

Sulphur fertilization at 30 to 40 kg ha^{-1} considerably altered the growth, production, nutrient uptake, and economics of oilseed crops. Oil content and oil output of oilseed crops increased as sulphur levels increased. Sulphur application during flowering has a considerable effect on the performance of oilseed crops. Sulphur application via gypsum has a substantial effect on the development, production, quality, and economics of oilseed crops.

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MICRO GREENS AND NUTRITIONAL SECURITY

Pretty Rani[1], Alam Prashanthi[2] and R. Geetha Reddy[3]

[1]Teaching Associate,
Department of Extension Education and Communication Management,
PJTSAU, Hyderabad
[2]Teaching Associate,
Department of Extension Education and Communication Management,
PJTSAU, Hyderabad
[3]Professor and University Head,
Department of Extension Education and Communication Management,
PJTSAU, Hyderabad
Corresponding author: prettyrani2510@gmail.com

Micro greens with its unique properties and flavors have gained public attractions in recent years. The Micro greens are added to raw veggies to enhance the flavor and nutritional values and they can also be used as edible toppings for decorating several food items. Micro greens are immature vegetable greens harvested after cotyledonary leaves are developed. Due to the large number of biologically active compounds like antioxidants, vitamins and minerals, the demand for micro greens is on the rise every day. Here in this article the potential health benefits, nutrients are discussed which contributes to the nutritional security.

Types of Microgreens

- **Brassicaceae family:** Cauliflower, broccoli, cabbage, watercress, radish and arugula
- **Asteraceae family:** Lettuce, endive, chicory and radicchio
- **Apiaceae family:** Dill, carrot, fennel and celery
- **Amaryllidaceae family:** Garlic, onion, leek
- **Amaranthaceae family**: Amaranth, quinoa swiss chard, beet and spinach
- **Cucurbitaceae family:** Melon, cucumber and squash

Cauliflower Micro Greens

Broccoli Micro Greens

Cabbage Micro Greens

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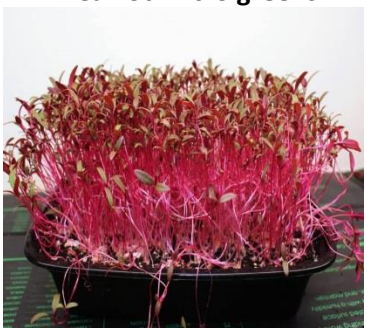
Lettuce Micro Greens

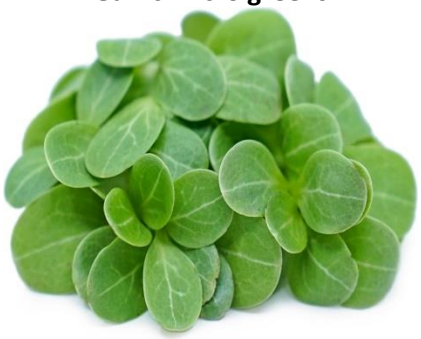
Carrot Micro greens

Garlic Micro greens

Spinach Micro greens



Amranthus Micro Green



Cucumber Micro Greens

Images: Common types of Micro greens

Micro greens and Nutrition

Micro greens are dense in nutritional content but with varying proportions. These micro greens contains K, Fe, Zn, Mg and Cu but the quantity varies. . Researchers have shown that level of nutrients in micro greens are up to nine times greater than those found in mature greens (Pinto et al., 2015). Micro greens contain ascorbic acid, carotenoids, phylloquinone, and tocopherols. Researches have indicated that Microgreens are loaded with anti-oxidants. These natural compounds that protect or delay cells from damage and may lower the risk of heart disease, cancer and other diseases.

Why to include Micro Greens in daily Diet?

1. **Lowers Blood pressure levels:** Micro greens are the foods that results to lowering the blood pressure levels in the body. The Micro greens are rich in fibres and vitamin K, hence these nutrients help in lowering of the blood pressure.
2. **Fights with Cancer**: Research is still going on these areas. But still researches have shown that sulforaphanea compound founds in Micro greens can fight with cancer.
3. **Improves Gut health**: Micro greens are rich in dietary fibers. Fibers prevent the problem of constipation, gastro intestinal stress and also aids in weight loss.
4. **Lowers the Cholesterol levels**: Micro greens lower the levels of LDL, Liver cholesterol and inflammatory cytokines which increases the risk of heart diseases.

Micro Greens and Nutritional security

Scientist have shown that micro greens cam be grown in soilless production systems, limited space, Presence of artificial sun lights. These observations are more appropriate after Covid-19

pandemic as the food supply chain was disrupted. Micro greens can also be grown in deserts, semi- arid or the soil with limited fertility.Nutrient-dense microgreens have great potential as an efficient food-resilience resource(Francesco Di Gioia, 2021.)

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MIRACLE GRAINS : CROPS OF THE FUTURE

Phurailatpam Menaka Sharma

Assistant Professor Agronomy, College of Agricultural Sciences,
FEEDS Group of Institute, Hengbung, Manipur
Corresponding author: sharmamenaka11@gmail.com

Abstract

The ever growing world's population is expected to reach 9.7 billion by 2050 from 7.7 billion currently. Along with the rising population comes various challenges in terms of basic food security. Millets are the group of small-seeded annual grasses that belong to Poaceae family and primarily grown for grain purposes. Millets can be grown in wide range of temperature and moisture regimes along with lesser input requirements. They are potential of addressing important issues such as food, fuel, feed, health, climate change etc. hence been termed as miracle grains. Year 2023 has been declared as International Year of Millets.

Introduction

Millets are nutritious small grained crops used for food and fodder purposes. They are drought tolerant and is grown extensively in Asia and semi-arid tropics of Africa. They are wonderful source of nutrients such as proteins, minerals, vitamins, fibre, phytonutrients etc. Millets are enriched with phytochemicals and antioxidants such as lignans, phytosterols, polyphenols, phyto-oestrogens, phytocyanins etc. their cultivation not only secures future food and nutrition at the same time keeping dryland productive.

World area under millet is 718 lakh hactre contributing 863 lakh tonnes. In India, earliest evidence was found in Indus valley Civilization around 3000 BC. Millets are grown in 131 countries and serves as traditional foods for 59 crore people in Asia and Africa. India accounts for 20 percent global production of millets with 138 lakh hactre area and total production of 173 lakh tonnes (FAO Stat 2021). Leading millets producing states in India are Rajasthan (Bajra/sorghum), Karnataka (Jowar/ragi), Maharashtra (Ragi/jowar), Uttar Pradesh(Bajra), Haryana(Bajra).

Millets can be categorized as follows:

1. Coarse grain millets

a) Sorghum *Sorghum bicolor*
b) Pearl millet *Pennisetum glaucum*

Source: https://lidea-seeds.com
Fig. 1. Sorghum

Source: https://plantix.net
Fig. 2. Pearl millet

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2. **Small grained millets**

a) Finger millet *Eleusine coracana*
b) Foxtail millet *Setaria italica*
c) Kodo millet *Paspalum scrobiculatum*
d) Barnyard millet *Echinochloa esculenta*
e) Little millet *Panicum sumatrense*
f) Proso millet *Panicum milliaceum*

Source: smartfood.org
Fig. 3. Fingermillet

Source: bnborganics.com
Fig. 4. Foxtail millet

Source: millets.wordpress.com
Fig. 5. Kodo millet

Source: marathivishwakosh.org
Fig. 6. Barnyard millet

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Source: dreamstime.com
Fig. 7. Little millet

Source: freshon.in
Fig. 8. Proso millet

Table 1. Cultivation practices of different millets
ICAR - Handbook of Agriculture 2019

Millet	Common name	Planting season	Seed rate	NPK	Yield
Sorghum *Sorghum bicolor*	Jowar	Kharif/ Rabi	8-10 kg/ha	60N-40P_2O_5 Kharif 40N-20P_2O_5 Rabi	50 quintals
Pearlmillet *Pennisetum glaucum*	Bajra	Kharif/ Summer/ Rabi	5 kg/ha	20-20-20 40-20-20 60-20-20	35 quintals
Fingermillet *Eleusine coracana*	Ragi/ Mandua	Kharif/ Rabi	10 kg/ha	40-20-20 60-30-20	25 quintals
Kodo millet *Paspalum scrobiculatum*	Kodo	Kharif	10 kg/ha	40-20-20	18 quintals
Foxtail millet *Setaria italica*	Kangani/ Kakun	Kharif/ Summer	8-10kg/ha	40-20	18 quintals
Proso millet *Panicum milliaceum*	Cheena	Kharif/ Rabi	10kg/ha	20-20	15 quintals
Little millet *Panicum sumatrense*	Kutki	Kharif/ Rabi	12 kg/ha	20-20	
Barnyard millet *Echinochloa frumentacea*	Sawan	Kharif	8-10 kg/ha	40-20-20	12-15 quintals

Table 2: Nutrient Content of different millets per 100 g

Millet	Energy	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Folic acid (mg)	Fibre (g)	Thiamine vitamin B_1 (mg)
Pearl millet	361	11.6	5.0	42.0	8.0	3.1	45.5	1.2	0.33
Sorghum	349	10.4	1.9	25.0	4.1	1.6	20.0	1.6	0.37

Millet	Energy	Protein (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Folic acid (mg)	Fibre (g)	Thiamine vitamin B_1 (mg)
Finger millet	328	7.3	1.3	34.4	3.9	2.3	18.3	3.6	0.42
Foxtail millet	331	12.3	4.3	31.0	2.8	2.4	15.0	8.0	0.59
Proso millet	341	7.7	4.7	17.0	9.3	3.7	9.0	7.6	0.21
Barnyard millet	397	6.2	2.2	20.0	5.0	3.0	0	9.8	0.33
Kodo millet	309	8.3	1.4	27.0	0.5	0.7	23.1	9.0	0.33
Rice milled	345	6.8	0.4	10.0	3.2	1.4	8.0	0.2	0.06
Wheat flour	346	12.1	1.7	48.0	4.9	2.2	36.6	1.2	0.49
maize	342	11.2	3.6	10.0	2.3	2.8	20.0	2.7	0.42

Gopalan *et. al.*,1989

Advantages of millets-

- Millets perform well under rainfed conditions.
- Millets are rich in micronutrients, minerals, vitamin B complex etc.
- Millets are rich in health promoting phytochemicals and can be used as functional foods.
- Millets can be grown in different agro-climatic zones with most millets can be grown on poor and low fertility soils.
- Millets sequestrate carbon and thereby reduce the burden of greenhouse gases.
- Finger millet has thirty times more Calcium than rice while every other millet has at least twice the amount of Calcium compared to rice.
- Nutrients in millets are miles ahead of rice, wheat and maize in terms of their mineral content.
- Iron content in proso millet and pearl millet are comparably more than that of rice.

Conclusions

Millets are great source nutrients and has potential to address food crisis in the world. Also they can be grown in harsh climatic conditions in semi-arid areas as well. Recently, millet based processed products and value added products are emerging as excellent choice for developing nutritious and healthier convenient food products.

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A REVIEW ON INDIAN GOVERNMENT SCHEMES IN DAIRY SECTOR

Adarsh M. Kalla and Devaraju. R

Assistant Professor, Dairy science college,
Mahagaon cross, Kalaburagi– 585316
Corresponding author: adarshkalla002@gmail.com

Introduction

India is ranked 1st in milk production contributing 23 % of global milk production. Milk production in the country has grown at a compound annual growth rate of about 6.2 % to reach 209.96 million tonnes in 2020-21 from 146.31 mn tonnes in 2014-15. The top 5 milk-producing states are: Uttar Pradesh (14.9%, 31.4 MMT), Rajasthan (14.6%, 30.7 MMT), Madhya Pradesh (8.6%, 18.0 MMT), Gujarat (7.6%, 15.9 MMT) and Andhra Pradesh (7.0%, 14.7 MMT).

The Government of India in association with the Department of Animal Husbandry and Dairying has brought up with many schemes and polices which would benefit the farmers and the dairy sector community. For example in June 2020 government announced a $ 2.1 Bn infrastructure development fund with an interest subsidy scheme to promote investment by private players and MSMEs in dairy, meat processing and animal feed plants which in return are expected to create 3.5 million jobs. The food processing ministry has extended the 'Pradhan Mantri Kisan Sampada Yojana (PMKSY)' scheme till March 2026 with an allocation of INR 4,600 crore. PMKSY is an umbrella scheme incorporating on-going schemes of the ministry like Integrated Cold Chain and Value Addition Infrastructure, Food Safety and Quality Assurance Infrastructure, Infrastructure for Agro-processing Clusters, Creation / Expansion of Food Processing and Preservation Capacities and Operation Greens. In this paper we will discuss different government schemes in dairy sector.

Government Schemes for Dairy Development

1. Dairy processing & Infrastructure Development Fund (DIDF)

The Scheme assists laon to State Dairy Federations, District Milk Unions, Milk Producers Companies, Multi State Cooperatives and NDDB subsidiaries across the country that is termed as Eligible End Borrowers (EEBs). The objective of scheme is to provide subsidized loan @6.5% to capital stressed milk cooperatives for primarily replacing their decades old chilling and processing plants and addition of value added product plants. The project focuses on building an efficient milk procurement system by setting up of processing and chilling infrastructure & installation of electronic milk adulteration testing equipment at village level. It also focuses on modernizing the milk processing plants and machinery and to create additional infrastructure for processing more milk.

It includes various components like Cattle feed/ feed supplement plants, Milk transportation system (van/insulated tankers etc), Marketing infrastructure (including e-market system, bulk vending system, Parlour, deep freezer, cold storage etc., Commodity and Cattle feed go-downs, ICT infrastructure (e.g. block chain technology, servers, IT solutions, Near Real Time devices etc), R&D (lab & equipment, new technology, innovations, product development etc), Renewable

energy infrastructure/plants/energy efficiency infrastructure, PET bottle/packaging material manufacturing units for dairy purposes and Training centre.

The scheme is implemented by National Dairy Development Board (NDDB) and National Cooperative Development Corporation (NCDC). The end borrowers will be Milk Unions, State Dairy Federations, Multi-state Milk Cooperatives, Milk Producer Companies and NDDB subsidiaries. The financial outlay for project components of DIDF is Rs 10,881 crore, out of which Rs 8,004 shall be loan from NABARD to NDDB/NCDC, Rs 2,001 crore shall be end borrowers contribution, Rs 12 crore would be NDDB/NCDC's share and Rs 864 crore shall be contributed by DAHD toward interest subvention. The funding period of the scheme is from 2018-19 to 2022-23 and the repayment period is up to 2030-31.

2. Animal Husbandry infrastructure development fund (AHIDF)

Prime Minister's Atma Nirbhar Bharat Abhiyan stimulus package mentioned the creation of a Rs.15,000crore Animal Husbandry Infrastructure Development Fund (AHIDF). The scheme's principal purpose is to boost milk and meat processing capability and product variety, raise farmers' price realisation, and encourage exports and increase the livestock industry's export contribution.

The AHIDF has been approved for incentivizing investments by individual entrepreneurs, private companies, MSME and Farmers Producers Organizations (FPOs). The activates eligible for availing the benefit under AHIDF include(i) the dairy processing and value addition infrastructure, (ii) meat processing and value addition infrastructure, (iii) Animal Feed Plant, (iv) Breed Improvement technology and Breed Multiplication Farm (v) Animal Waste to Wealth Management (Agri Waste Management) and (vi) Setting up of Veterinary Vaccine and Drugs Manufacturing facilities. AHIDF will be implemented by the Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying.

The main objectives of the AHIDF include:

a. To help increasing of milk and meat processing capacity and product diversification thereby providing greater access for unorganized rural milk and meat producers to organized milk and meat market
b. To make available increased price realization for the producer
c. To make available quality milk and meat products for the domestic consumer
d. To fulfill the objective of protein enriched quality food requirement of the growing population of the country and prevent malnutrition in one of the highest malnourished children population in the world
e. Develop entrepreneurship and generate employment
f. To promote exports and increase the export contribution in the milk and meat sector.
g. To make available quality concentrated animals feed to the cattle, buffalo, sheep, goat, pig and poultry to provide balanced ration at affordable prices.

3. National Programme for Dairy Development (NPDD)

National Programme for Dairy Development (NPDD) scheme comes under department of animal husbandry and dairying. It aims to enhance quality of milk and milk products and increase share of organised procurement, processing, value addition and marketing. This scheme has two components:-

(i) Component A: focuses towards creating/strengthening of infrastructure for quality milk testing equipment as well as primary chilling facilities for State Cooperative Dairy Federations/ District Cooperative Milk Producers Union/SHG run private dairy/Milk Producer Companies/Farmer Producer Organisations.
(ii) Component B: provides financial assistance from Japan International Cooperation Agency (JICA) as per project agreement already signed with them. The central Government share in this project is proposedto be funded through NPDD.

4. Pradhan Mantri Kisan Sampada Yojana (PMKSY)

PMKSY is a comprehensive package which will result in creation of modern infrastructure with efficient supply chain management from farm gate to retail outlet. It will not only provide a big boost to the growth of food processing sector in the country but also helps in providing better prices to farmers creating huge employment opportunities especially in rural areas, reducing wastage of agricultural products, increasing the processing level and enhancing the export of the processed foods.

The following schemes are implemented under PM Kisan SAMPADA Yojana :

1. Integrated Cold Chain and Value Addition Infrastructure
2. Creation/ Expansion of Food Processing and Preservation Capacities (Unit Scheme)
3. Infrastructure for Agro-processing Clusters
4. Food Safety and Quality Assurance Infrastructure
5. Human Resources and Institutions –Research & Development
6. Operation Greens

PM Kisan Sampada Yojana is estimated to leverage investment of INR 11,095.93 crore, benefiting 28,49,945 farmers and generating 5,44,432 direct/indirect employment in the country by the year 2025-26.

5. Kisan credit card (KCC) to livestock farmers

The Department of animal husbandry and dairying has conducted a special drive for providing all dairy farmers of Milk Cooperatives and Milk Producer Companies with Kisan Credit Cards (KCC).The Indian dairy cooperatives are associated with approximately 1.5 crore farmers and 230 Milk Unions in the country. Hence government had taken initiative to provide Kisan Credit Card (KCC) to these 1.5 crore dairy farmers belonging to Milk Unions and Milk producing Companies. The Kisan Credit Card scheme aims at providing adequate and timely credit support from the banking system under a single window with the flexible and simplified procedures to the animal husbandry and fisheries farmers for their working capital requirements. So far53.10 lakh applications of Dairy farmers have been collected by Milk Unions and 45.75 lakh applications forwarded to the Banks. From recent data under a nationwide KCC campaign by the Department of Animal Husbandry and Dairying, 50,454 KCC were sanctioned from 15.9.2021 to 17.12.2021.

6. Rashtriya Gokul Mission (RGM)

Rashtriya Gokul Mission (RGM) has been launched in December 2014 with an outlay of Rs2025 crore for development and conservation of indigenous breeds through selective breeding in the breeding tract and genetic upgradation of non-descript bovine population. The scheme comprises of two components namely National Programme for Bovine Breeding (NPBB) and National Mission on Bovine Productivity (NMBP).

Objectives of RGM:

a. Development and conservation of indigenous breeds
b. Breed improvement programme for indigenous breeds so as to improve the genetic
c. makeup and increase the stock
d. Enhancing milk production and productivity of bovine population by increasing disease free high genetic merit female population and check on spread of diseases
e. Upgrading nondescript cattle using elite indigenous breeds like Gir, Sahiwal, Rathi, Deoni, Tharparkar, Red Sindhi
f. Distribution of disease free high genetic merit bulls for natural service
g. To bring all breedable females under organised breeding through AI or natural service using germ plasm of high genetic merits
h. To arrange quality Artificial Insemination (AI) services at farmers' doorstep
i. To create e-market portal for bovine germplasm for connecting breeders and farmers
j. To increase trade of livestock and livestock products by meeting out sanitary andphyto-sanitary (SPS) issues
k. To select breeding bulls of high genetic merit at a young age through application of genomics.

Significant initiatives under RGM:

In order to motivate farmers for rearing of indigenous breeds and to enhance the production and productivity of indigenous breeds, the following awards have been instituted under RGM every year.

a. Gopal Ratna awards: For farmers maintaining the best herd of Indigenous Breed(s) and practicing best management practices.
b. Kamdhenu awards: For Best managed Indigenous Herd by Institutions/Trusts/NGOs/ Gaushalas or best managed Breeders' Societies.

There are three Gopal Ratna awards (1st, 2nd and 3rd position) and three Kamdhenu awards respectively for five regions viz: i) Hill and North Eastern; ii) North; iii) South; iv) East and v) West. Each award will consist of a citation and an incentive of Rs 5,00,000/-,Rs.3,00,00/-and Rs 1,00,000/- each respectively for 1st, 2nd and 3rd position for every region. In case of equal scoring the cash incentive component of the award is shared accordingly. Awards under the mission are being bestowed since 2017-18 and so far 22 Gopal Ratna and 21 Kamdhenu awards have been distributed. The Rashtriya Gokul Mission also envisages establishment of integrated cattle development centres called 'Gokul Grams' to develop indigenous breeds including upto 40%nondescript breeds.

Conclusion

The State governments have to support the dairy industry in those areas where milk availability and output are below average nationally. They can facilitate the promotion of the cooperative model in these regions, to channelise and formalise milk procurement, which will help millions of people to be gainfully employed.They can channelise funds from different Central government schemes like National Programme for Dairy Development (NPDD), and DIDF (Dairy Processing & Infrastructure Development Fund. These schemes will support private investments in dairy processing and value addition, and welfare of cattle health and cattle feed infrastructure. This will

not only give a boost to local manufacturing and consumption of locally produced goods but will also help the national consumer become “vocal for local”; thus taking India forward on the path of self-reliance.

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KISAN CREDIT CARD SCHEME IN FISHERIES SECTOR

Mahendra Kumar Yadav[1*], Nitesh Kumar Yadav[2] and Shri Ram Yadav[3]

[1]Assistant Professor, School of Agriculture, SAGE University, Bhopal (M.P.) India
[2]P.hD Scholar, College of Fisheries, Central Agriculture University, Lembucherra, Tripura
[3]PG Scholar CCS Haryana Agricultural University, Hisar - 125004, India
Corresponding author: mahendray459@gmail.com

Introduction

The Government of India, in the year 2018-19, extended KCC facility to fisheries and animal husbandry farmers to help them to meet their working capital requirements. Detailed guidelines were issued by the Reserve Bank of India (RBI) on 4 February 2019 covering eligibility criteria, funding scope, etc. Banking authorities have been instructed to issue his KCC within 14 days of receiving a farmer's completed application.

Purpose : KCC facilities meet short-term credit requirements for raising fish, shrimp, and other aquatic life.

Eligibility : The criteria for KCC livestock and fisheries eligible beneficiaries are:

KCC in Fisheries Sector

A. Inland Fisheries and Aquaculture

Fishermen, fish farmers (individual and groups/partners/farmers/farmers), self-help groups, co-responsibility groups, women's groups. Beneficiaries own or lease fishing-related activities such as ponds, tanks, open water, carrier trucks, hatcheries, breeding units, etc., and hold necessary licenses for fish farming and fishing-related activities, and all other state-specific fishing must have cooperation activity.

B. Marine Fisheries

Beneficiaries listed in (A) above who own or lease registered fishing vessels/boats are eligible for estuary and offshore fishing, estuary and offshore aquaculture/marine farming activities, and all other state-specific holds the necessary fishing licenses/permits for fishing and related activities.

Scale of Finance

Funding levels are determined by the District Technical Committee (DLTC) based on local costs calculated on a per acre/per unit/per animal basis.

- The components of working capital in fisheries include seeds, feed, organic and inorganic fertilizers, lime/other soil conditioners, harvesting and marketing costs, fuel/electricity costs, labor costs, rental costs (water may include recurring expenses such as leased area).
- For captive fisheries, working capital may include fuel, ice and labor costs. Mooring and landing costs may also be eligible for financing.
- Government fisheries and livestock experts. May be appointed as a member of the DLTC to provide technical input for evaluating caching requirements.
- Advanced livestock/fisheries entrepreneurs are also included in the DLTC and can provide field level input while assessing working capital requirements.

Credit Limit for interest subvention and prompt repayment incentive:

- For the prevailing KCC holders the benefits of notice subvention and early repayment encouragement will be acceptable up to the credit limit of Rs. 3 lakhs including fisheries activities.
- While the new card holders will have credit limit of Rs. 2 lakhs to meet their working capital necessities for fisheries activities.
- Interest subsidy will be accessible for fisheries farmers as per the prevailing guidelines, i.e. @2% per annum at the time of disbursal of loan and extra @3% per annum in case of rapid repayment as additional incentive.

Disbursement

The short-term component of the KCC Limit features a revolving cash credit facility. There is no limit to the number of debits and credits. Banking authorities have been instructed to issue a KCC to him within 14 days of receiving the completed application form from the fish farmer.

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IMPORTANCE OF GREEN MANURING IN ORGANIC AGRICULTURE

S Kinge[1*] and A. J. Rathod[2]

[1] Ph.D, Scholar, Department of Agronomy
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli
[2]Ph.D, Scholar, Department of Agronomy
PGI, Mahatma Phule Krishi Vidyapeeth Rahuri.
Corresponding authors: sunilkinge40@gmail.com

Organic farming

"An Ecological Production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off farm inputs and on management practices that restore, maintain and enhance ecological harmony".

Goal

"The role of Organic agriculture, whether in farming, processing, distribution or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings."

Common organic farming practices

- Biofertilizers
- Crop rotation
- Green manure
- Compost
- Biological pest control
- Mechanical Cultivation
- New generation Biotech Organic Inputs

Green Manuring

The practice of ploughing or turning into soil under-composed green plant tissue for the purpose of improving physical condition as well as fertility of the soil is referred to as green manuring and the manure obtained by this method is known manure. as green

Green manure crop characteristics:

- The green manure crops should have profuse leaves and rapid growth early in its life cycle.
- The green manure crops should have abundance and succulent topsbe capable of making a good stand on poor and exhausted soils.
- Have a deep root system.
- Be legume with good nodular growth habit.
- Use of leguminous green manure crop is more useful in comparison to non-legumes, as more nitrogen is added by legumes. This will be advantageous for the soils and crops grown after green manuring.

Green Manure

Green undecomposed material used as manure is called green manure. It is obtained in two ways:

- By growing green manure crops or
- By collecting green leaf (along with twigs) from plants grown in wastelands, feld bunds and forest.
- Green manuring is growing in the field plants usually belonging to leguminous family and incorporating into the soil after sufficient growth. The plants that are grown for green manure known as green manure crops.

Green Manuring Crops

These crops include close growing plant species raised mainly for protection of soil. Dhiancha, Sunhemp, Soybean, Moong, Urd, Cowpea, ground nut, velvet bean, lemon grass and other wild grasses etc. are used as cover crops in the organic farms as well as the waste lands around the farm, serving purpose of fodder, green manure etc. Besides protecting the soil from erosion alongside the bunds and strips.

Green Manuring Crops

- Dhiancha
- Sunhemp
- Sesbania
- Soybean
- Moong
- Urd
- Cowpea
- Ground nut,
- Velvet bean,
- Lemon grass and
- wild grasses etc.

Green Manuring Practices

Green manuring is the practice of growing lush plants on the site into which you want to incorporate organic matter, then turning into the soil while it is still fresh. The plant material used in this way is called a green manure. Generally, the practice of green manuring is adopted in two ways:

a) In-situ green manuring

In this system the short duration legume crops are grown and buried in the same site when they attain the age of 60-80 days after sowing. This system of on- site nutrient resource generation is most prevalent in northern and southern parts of India where rice is the major crop in the existing cropping systems.

Leguminous green manures

- Sesbania
- Dhaincha
- Sunhemp
- Wild Indigo
- Pillipesara
- Cowpea
- Cluster bean (Guar)

- Green gram (Mung bean)
- Berseem
- Madras Indigo

b) Green leaf manuring

Green leaves and tender plant parts of the plants are collected from shrubs and trees growing on bunds, degraded lands or nearby forest and they are turned down or mixed into the soil 15-30 days before sowing of the Crops depending on the tenderness of the foliage or plant parts. Application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere is known as green leaf manuring. Forest tree leaves are the main sources for green leaf manure. Plants growing in wastelands, field bunds etc., are another source of green leaf manure. The important plant species useful for green leaf manure are given below:

- Neem
- Mahua
- Wild Indigo
- Glyricidia
- Karanji (Pongamia Glabra)
- Calotropis
- Avise (Sesbania Grandiflora)
- Subabul

Benefits

1. Nitrogen fixation:

The main benefit of using a legume as a green manure is that legumes fix nitrogen from the atmosphere and convert it into a form that is available to other plants. Legumes from a symbiotic association with soil bacteria called rhizobium. These bacteria colonize the root hairs of the legumes and multiply causing swellings, which become nodules. The bacteria benefit from the relationship by obtaining carbohydrates (plant sugars) from the legume. The growing legume benefits from the nitrogen that is captured from the air and converted into ammonium legume benefits from the nitrogen that is captured from the air and converted into ammonium within the nodules.

2. Supplement for nutrients:

Different green manures and grain-legumes are used to increase the nitrogen content and texture of the soil. Among the green manures Sesbania aculeata accumulated the largest amount of biomass and nitrogen contribution and among the grain legumes, cowpea ranks first both in terms of grain yield and biomass addition. The available green manure crops and utilization pattern are as follows:

3. Improved soil structure:

Green manures improve soil structure, letting more air into the soil and improving drainage. Green manures help sandy soil hold more water and not drain so quickly. Prevention of soil erosion green manures help to stop the soil being carried away by wind and rain. The roots penetrate the soil and hold it in place.

4. Weed Control:

Green manures help to control weeds. Bare soil can become quickly overgrown with weeds, which can be difficult to remove. Green manures cover the ground well and stop weeds growing beneath them, by competing for nutrients, space and light.

5. Place in farming system:
Green manures in rotation: Growing green manures as part of a crop rotation is an important part of an organic farming system. These help to build soil fertility and are particularly useful when grown before crops, which need a lot of nutrients. Green manures can be used in rotation : 1. Whenever there is no crop in the ground, rather than leaving the land bare and allowing weeds to grow and nutrients to leach out of the soil. 2. As break crops, when these is only a short time between main crops.

6. Green manures as mulch:
Green manure plants can be cut and left on the soil surface as a mulch. Mulching releases nutrients slowly but has some advantages:

- Mulching helps to prevent weed growth.
- Mulching protects the soil from erosion.
- Mulching keeps the soil moist by reducing evaporation.

7. **Green manures in agroforestry:**
Agroforestry is the practice of growing trees and/or shrubs together, with crops and/or animals. The trees/shrubs act as long-term green manures and the leaves can be used to digging in or as a mulch. The regular pruning of agroforestry trees such as Leucaena (Leucaena leucoephata), Mother of cocoa (Glyricidiasepium) and Calliandra (Calliandracalothyrsus) during the crop growing period provides large amounts of green material for digging into the soil and reduces competition with the main crop. The material can also be used as a mulch. It is spread on the top soil, usually between crop rows or before a crop has been planted. As well as improving the soil in the ways described above, trees and shrubs also provide food, fodder, fuel wood, erosion control and other benefits.

Conclusions
A number of conclusions can be drawn from the examples given above:

The variety of sustainable green manure and crop cover systems already established in traditional as well as more recently introduced agricultural system is remarkably diverse. Green manures and cover crops have been adopted on a wide scale despite the seemingly prohibitive conditions. The fact that virtually every system referred to has some elements of these conditions confirms their predictive value. Thus, programmes to introduce new green manure and cover crop systems should teach farmers not only how these species can be used to improve their soil but that they have other uses as well.

Tremendous potential still exists for the development of new green manure and cover crop system. Scope of potential systems for using green manure and cover crops still need to be investigated, most notably the major possibilities of using them for animal feed; the potential latent in new as yet untried species, including trees and non-legumes, and the value of combining of green manures and cover crops rather than using individual species.

Experience leads us to believe that, with the possible exception of very intensive farming systems such as irrigated vegetable and rice, green manure and cover crop systems can probably be introduced into many, if not most of the world's small scale farming systems.

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PRE-BREEDING : WILD GENE INTROGRESSION APPROACH

Pranjal Shedge[1], Pramod Sargar[2] and Smita Deshmukh[3]

[1]Research Scholar, Pulses Breeding Programme.
ARS, Badnapur. Jalna, India. 431 202.
[2] Research Scholar, Sorghum Breeding Programme.
ICRISAT, Patancheru. Telangana, India. 502 324.
[3] Research Scholar, Department of Agricultural Botany (Genetics and Plant Breeding)
V.N.M.K.V., Parbhani. Maharashtra. India 431 402.
* Corresponding Email – pranjalshedge22@gmail.com

Introduction

Enhancing plant breeding Progress and genetic diversity that already exists in plant genotypes is essential for sustainable system of agriculture and to supply the world's food security which is made feasible by innovative Strategies. It is unexpected to learn that even though there is a vast accumulation of genetic material, yet there is very less usage of germplasm accessions (1%) in the breeding plan because of a cross existing incompatibility and undesired linkage drag in the germplasm of the wild species. Genetic resources for plants are stores for naturally occurring genetic variability, and supply the necessary inputs for crop improvement programmes. Upto now 7.4 million germplasm of several crop accessions have been gathered and/or put together and preserved for more than 1750 global ex-situ gene banks (FAO, 2010). Narrowing down of genetic base and less use of genetic resources are the main reasons for lowering the production and productivity in crop plants and pre breeding provides the mean to overcome these sufferings.

What does pre-breeding mean?

Pre-breeding is the term used to describe all procedures intended to isolate desirable traits and/or genes from unadapted (foreign or semi-exotic) materials, including those that, while being adapted, have undergone to any sort of decision for enhancement. It is a crucial component of initiatives for germplasm diversification. It is the most effective method of tying breeding programmes and genetic resources together.

Pre-breeding refers to all methods used to extract desirable qualities from unsuitable materials that cannot be employed directly in breeding populations and to transmit these traits to new populations. A base set of components that breeders can build upon to create new cultivars for farmers. It is an essential initial step in "connecting genetic variability to use," the use of variation resulting from wild family members and other raw supplies.

Why is pre-breeding necessary?

Breeding progress is hampered by a perceived lack of diversity.

- Food security is clearly threatened by the agriculture industry's presenting restricted genetic base.
- Biodiversity decline: Genetically homogenous modern varieties are replacing very varied kinds landraces and regional cultivars in conventional agro-ecosystems.
- Genetic homogeneity: Enhancing genetic susceptibility to diseases and pests.
- To better adapt to the consequences of climate change, researchers are looking for novel genes and features.

- Plant breeders are being prompted by changing pest and pathogen populations to hunt for new sources in gene banks with resistance.

Pre-breeding is decided depending on the anticipated effectiveness and efficiency of eventually transferring the goal features into cultivars for farmers as well as the source of desired gene (s). Pre breeding is required if desired genes possessed by only one of the following :

(1) Gene bank accession materials that are poorly suited to the target environment; (2) Closer wild species that are more easily hybridised with agricultural crop species; and (3) More distant wild species that are more arduous to cross techniques for pre-breeding.

Methods of pre breeding

There are two methods that can make pre-breeding effective: introgression and integration (incorporation). Introgression is the transfer of one or more genes from donor germplasm that has not been optimised into an agronomically adopted superior breeding stock (recurrent parent). This can be done by using concept of introgression by backcrossing and recurrent backcrossing which is elaborated by Dr. Edger Anderson. Parents' recombination frequency can be increased by three different backcrossing techniques.

Backcrossing repeatedly : This technique entails backcrossing the cross repeatedly (often six times) created between the donor parent and the recurrent parent, with or without selection made for the recurrent parent.

Inbred backcross: Wehrhahn and Allard (1965) were first suggested this method which includes few backcrosses and several generations of selfing.

Congruity backcross: Backcrossing is carried out using both donor and recurrent parent from a different generations. Haghighi and Ascher suggested this approach in 1988.

Convergent Improvement: This technique involves backcrossing the resulting single cross hybrid with both parents separately. Richey was the one who first put forward this (1927).

Construction of Composites/Synthetics: With this approach, crossing between
broad range of parents and germplasms is carried out to produce very heterogeneous stocks having boad genetic base that acts as a storehouse for the desired trait.

Decentralized Breeding: Simmonds coined the phrase "decentralised selection," in 1984. The primary step in this strategy is selection at the target location or environment.

Participatory Plant Breeding: In this breeding technique, breeders and farmers work together, and their interactions to enhance locally adapted germplasm. The basic plan for this method is provided by Witcombe et al., 1996.

Using the Gene Pool and Foreign Germplasm

Gene pool:

Comprised of all genetic diversity, or the degree of diversity present in a crop species and its alleles exist in all individuals that can cross with each other.

Exotic germplasm

Crop varieties that are unsuited to the habitat and a breeder hopes to breed in, and it is a crucial tool for crop development are referred to as exotic germplasm. The genetic material of land races, modern cultivars, obsolete varieties, breeding stocks, wild varieties and wild both cultivated and uncultivated species of crops and wild species.

Pre-breeding involves a variety of activities (Shimelis and Laing, 2012)

Populations of landraces are described as follows:

Landraces are native plant species that have been developed to grow in a particular agro-ecological and farming system devoid of any kind of scientific selection. Usually, landraces are heterogeneous and for crop breeding operations, serves as a great source of genetic diversity (Sleper and Poehlman, 2006). Landraces harbor the genes that are helpful include those for features like early maturation, high yield potential, disease and insect resistance, and other desired traits. The areas with the largest diversity are those where landraces are most common. They can be identified using a number of markers.

New parent populations' creation

A crop breeding program's effectiveness depends on selecting the best parents with complementing and desired qualities. Breeders therefore regularly choose possible parent populations from a variety of sources, such as landraces, wild or semi-wild species, old or primitive cultivars, and modern cultivars. Parents with high-specific or general combining ability are chosen by carefully planned recombination and progeny testing. Testing of progeny is performed using test crosses, recombinant DNA, half-sibs, or full-sibs in a range of target and representative habitats (Acquaah, 2007; Brown and Caligari, 2008).

Introgression of new characteristics from other useful sources

The plant breeder creates a new variety from an intermediate variety with strong agronomic potential but lacking a particular characteristic by transferring one or more desirable traits from unrelated, exotic or semi-exotic, landrace, or related germplasm (Simmonds, 1993). As a result, the new variety will be created using the unique gene(s) introduced into the existing genetic background. Races, populations, clones, inbred lines, and other types of genetic organisation can all be found in exotic germplasm (Hallauer and Miranda Filho, 1988). Introducing genes from unrelated, exotic, primitive, or wild germplasm is a process that involves both the desired gene(s) and a sizable proportion of undesired genes which has to be eliminated through repeated backcrosses with recurrent parent (Brown and Caligari, 2008).

Development of novel traits

Mutations cause spontaneous genetic changes in an individual that are frequently heritable. Naturally, there is low frequency in occurrence of mutational events, i.e., 10^{-5} to 10^{-8} per locus. In plant breeding and functional genomics, artificial means of inducing mutagenesis mutagenic agents are a crucial technique to improve the frequency of mutations, which will increase genetic diversity. Successful applications of induced genetic variants can be found in many crops to produce beneficial mutations (Ahloowalia et al. 2001; Pozniak and Hucl, 2004; Hohmann et al., 2005). The method is recognised as an effective choice for improving germplasm for key agronomic properties (Pozniak and Hucl, 2004). The novel mutational events can either be created directly as fundamentally derived varieties or novel genes can be introduced into potential parents through a back cross method.

Development of polyploidy

The breeder can introduce novel variety by adjusting the number of chromosomes in a species, either by adding or deleting particular chromosomes or changing the basic chromosome set (s). Individuals with a changed chromosomal set (euploids) are created by either crossing two unrelated species and then doubling of the inter-specific hybrid's chromosomes or by doubling the number of a species' genome.

There are several ways for artificial production of polyploidy, including exposing plant materials to environmental shock (such as x-ray radiation, low or high temperature treatment) or substances that interfere with regular chromosomal division, such as colchicine. (Sleeper and Poehlman, 2006; Acquaah, 2007; Brown and Caligari, 2008).

Acquiring new information about crop genetics

For improved nutritional attributes, early maturity, high production potential, and resistance to biotic and abiotic stress, breeders are continually looking for new genes from various sources. Knowing about the pattern of expression of candidate genes and importance of inheritance in governing these characteristics is profoundly significant for effective transfer and improved selection effectiveness in cultivar development (Ortiz et al., 2008; Meneely, 2009).

Creation of novel plant breeding methods

Modern and innovative breeding methods can help to enhance selection responsiveness. They include creating conventional selection methods that are more effective, biotechnology, molecular marker technologies, and the identification of markers associated with desired genetic characteristics, efficient gametocides, and cytoplasmic sterility systems with a desired genetic background (Acquaah, 2007; Brown and Caligari, 2008; Lusser et al., 2012).

Development of cultivars

The development of cultivars includes specific breeding techniques aimed at creating cultivars that are better suited to the crop's mating system. For the development of a cultivar there is a requirement of breeding material that is highly developed and elite for which can be generated by a relational and well-established pre-breeding scheme. If applicable, locally screened and adapted germplasm can be a good place to start for developing cultivars. A plant breeder can invest a lot of time in pre-breeding to employ the best adapted parental material that is available and locally modified to fit the needs of a defined set of day- length requirements for a given latitude and agro-ecological zone. As an alternative, the breeder could use superior material (such as inbred lines) created by other breeders, such as germplasm available from CGIAR centers that is not locally. As a result a plant breeder will be able to release new candidate cultivars, even if those cultivars are not yet adapted to the local agro-ecological and cropping system into which they are to be released. The local farmers frequently reject the new cultivars since they are not bred to farmer’s preferred traits, despite the fact that the released cultivar may have some superior qualities. So, pre-breeding program must focus on two parallel programs simultaneously, i.e., both the continuous development of new and superior parent materials with superior traits of commercial importance consisting of features that would be preferred by farmers.

Applications of doubled haploids in plant breeding.

The simplest way to create pure breeding doubled haploids (DHs) is through in vitro haploid plant creation followed by somatic chromosomal doubling (Choo et al., 1985, Donoughue and Bennet, 1994). Haploides are created through a variety of methods, including another culture (Henry and De Buyser, 1990) or genome elimination following distant hybridization (Barclay, 1975; Matzk and Mahn, 1994; Singh et al., 2001). Double haploids are used for mapping quantitative trait loci, backcross breeding, bulk segregant analysis, genetic mapping, elite crossing and cultivar development etc.

Wide and prebreeding crosses (Haussmann et al., 2004)

Prebreeding involves fundamental research to produce wide crosses as well as activities that make it easier to use exotic materials or wild relatives.

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It can refer to both qualitative and quantitative characteristics, as well as the distinction between prebreeding, incorporation and introgression are not always obvious. The primary goal is to give more attractive PGR that are simpler to employ, to the breeders, such as sources of resistance with a suitable genetic background or inbreeding-tolerant varieties of out crossing species for hybrid breeding. The International Potato Center's resistance breeding programme serves as one such example In its Global Initiative on Late Blight (GILB) (Trognitz et al., 2001), with an objective to provide new sources of resistance from wild relatives to breeders and famers. Commercial breeders of sugar beet (Beta vulgaris) engage in prebreeding activities, or the creation of "Base" or "Buffer" populations from incredibly varied genetic materials (Frese et al., 2001; Frese, 2002).

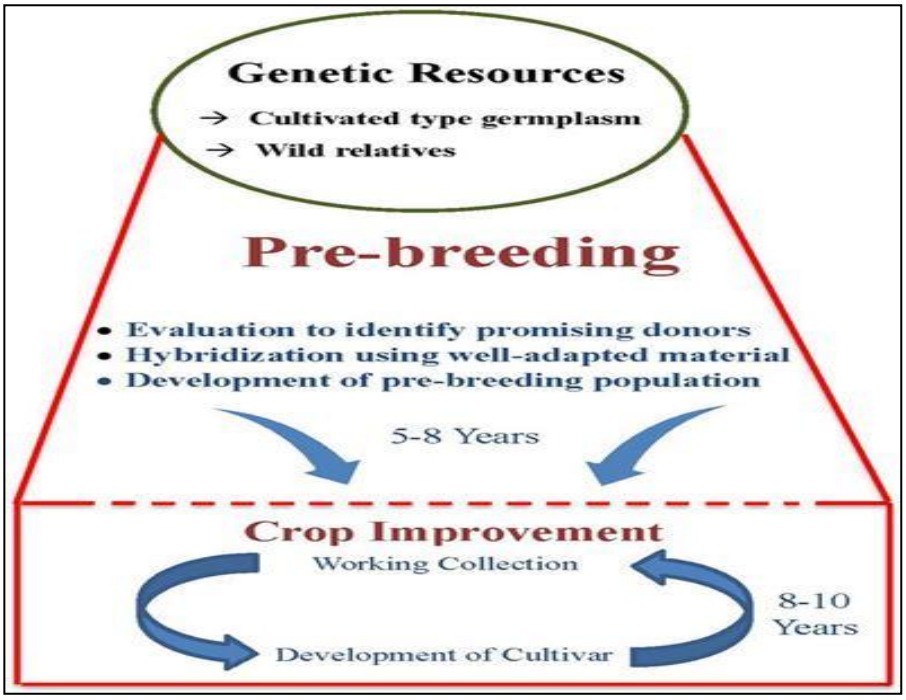

Figure: 1 Pre-breeding a bridge between genetic resources and crop improvement. (Sharma *et al*., 2013)

Pre-breeding difficulties and promises for the future

- ✓ The main issues with pre-breeding are a lack of characterization and assessment of genetic diversity, data documentation, a robust breeding program and funding sources.
- ✓ The previously noted challenges highlight the importance of need of collecting, characterizing, and documentation of wild species including crop wild relatives due to the increased chance of narrowly suited and endemic species going to be extinct species.
- ✓ There is more and more demand for novel genes in collections of germplasm and gene banks to make agriculture resilient/tolerant biotic and abiotic species.
- ✓ Genome mapping, gene decoding, and synteny among the genes could be assigned to conceal the stress tolerance and can be utilized for crop improvement.

The potential of genetic transformation technique could be exploited to transfer the desired genes form the tertiary gene pool and/or beyond. New breeding strategies and bioinformatics tools are required to use the information gathered from genetic and genome analysis programs for dealing with complex trait more effectively.

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PRECISION FARMING

Pratiksha J. Karpe*, Niranjan R. Chavan and Ashwini A. Ingle

MSc. Agri. (Agronomy), College of Agriculture, Latur
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
*Corresponding author: karpepratiksha66@gmail.com

Precision Farming

"Application of technologies and principles to manage spatial and temporal variability associated with all aspects of agricultural production".

Why precision farming?

- To increase agriculture productivity
- Prevents soil degradation
- Reduction of chemical application in crop production
- Efficient use of water resources
- Dissemination of modern farm practices to improve quality, quantity and reduced production
- Developing favorable attitudes
- Precision farming changes the Socio-economic status of farmers

Components of Precision Farming

1. Global Positioning Systems (GPS)
2. Geographic Information Systems (GIS)
3. Variable Rate Technology (VRT)
4. Yield Monitors
5. Remote Sensing
6. Proximate Sensors
7. Computer Hardware & Software
8. Irrigation System
9. Leaf Color Chart (LCC)
10. Soil Plant Analysis Development (SPAD) Meter or Chlorophyll Meter
11. LASER Land Leveler
12. Grid Sampling

Issues for Precision Farming in India

1. Small land holding
2. Lack of technical expertise Knowledge & Technology
3. Connectivity in rural areas
4. Making sense from big data in agriculture
5. Non-awareness of the varying farm production functions
6. Size of individual management zones
7. Barriers to entry for new firms
8. Lack of scalability and configuration problems
9. Energy depletion risks
10. Technical failures and resultant damages

11. Loss of manual employment
12. The security factor
13. Benefits not immediately apparent

Precision farming concerns for Indian agriculture

1. Farmers in developed countries typically own large farms (10-1000 ha or more) and crop production system are highly mechanized in most cases.
2. Large farms may comprise several fields in differing conditions.
3. Optimum growth and development are thus not achieved.
4. There is inefficient use of inputs and lab labour.
5. In conventional agriculture, although a soil map of the region may exist, farmers still tend to practice the same crop management throughout their field: Crop varieties, land preparation, fertilizers, pesticides are uniformally applied in spite of variation.

Advantages of Precision Farming

1. Saving Time
2. Reduce or maintain application costs of Fertilizers, Pesticide, etc.
3. Provide better farm records for sale and succession.
4. Minimizing Environmental impact
5. Better decision making in agricultural management.
6. Reduce or maintain Soil, Air, Water pollution.

Drawbacks of precision farming

1. High cost
2. Lack of technical expertise knowledge and technology
3. Not applicable or difficult/costly for small land holdings
4. Heterogeneity of cropping systems and market imperfections
5. Maintenance

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BUDGET 2023-2024 AND CATASTROPHE ON ADANI GROUP

Abdullah Zaid[1*] and Bisma Farooqui[2]
[1]M.Sc. Research Scholar, College of Horticulture
Banda University of Agriculture and Technology, Banda Uttar Pradesh
[2] Aligarh Muslim University, Aligarh Uttar Pradesh
*Corresponding author, Email: abdullahzaid265@gmail.com

Abstract
Economic Survey 2022-23 highlights that the transformative reforms undertaken by the government had lagged growth returns due to temporary shocks in the economy. GDP forecast for FY24 to be in the range of 6-6.8%, depending on the trajectory of economic and political developments globally. Capex of central government increased by 63.4% during first 8 months of FY23, The Centre's Capex has steadily increased to 2.5% of GDP in FY22 PA (Provisional Actual) from 1.7% of GDP (FY19 to FY20). It is further budgeted to increase to 2.9% of GDP in FY23.Urban Unemployment Rate was at four-year low at 7.2% in September 2022. Credit growth to MSME was Over 30.6% on an average during Jan-Nov 2022, Government on track to achieve fiscal deficit target for FY23 (6.4% of GDP). Robust growth in the direct taxes (grew at 26% YoY) due to corporate and personal income tax growth. GST has stabilized as a vital revenue source for central and state governments, with the gross GST collections increasing at 24.8% on YoY basis from April to December 2022. GST Tax payers doubled to 1.4 crore in 2022. The repo rate was raised by 225 bps since April 2022 (increased from 4% to 6.25%). Tightened Monetary Policy reduced the liquidity in the market. The Gross Non-Performing Assets (GNPA)ratio decreased from 8.2% in 2020 to 5.0%in 2022, which is a seven year low. And now at the beginning of the new financial year, Hindenburg report has already done damage to stock market and more precisely to the Adani group where Adani group is saying there fundamentals are strong and balance sheet is clear, this report is only a corporate rivalry.

Budget 2023-2024
Finance Minister Nirmala Sitharaman presented the 2023-2024 Union Budget. The Union Budget 2023 strikes a fine balance between fiscal prudence and economic stimulus, offering a roadmap for sustainable growth in India and emphasis on boosting infrastructure investment, setting a clear target of bringing the fiscal deficit down to below 4.5 percent by 2025-26, as well as measures aimed at inclusive growth and employment generation. Budget 2023-24 consist of Total estimated receipts of Rs 27.2 lakh crore (excluding borrowings), Total estimated expenditure of Rs 45 lakh crore, Net tax receipts of Rs 23.3 lakh crore and Fiscal deficit 5.9% of GDP. To finance the fiscal deficit in 2023-24, the net market borrowings from dated securities are estimated at Rs 11.8 lakh crore. The gross market borrowings are estimated at Rs 15.4 lakh crore. The Finance Minister stated that all states must utilize their fifty-year loan for capital expenses by the end of 2023-24. 157 new nursing colleges will be established in co-location with the existing 157 medical colleges established since 2014, A Mission to eliminate Sickle Cell Anemia by 2047 will be launched, Changes in the new income tax regime (in rebate limit and in tax slabs), A 33% increase in capital investment outlay has been proposed, raising it to Rs 10 lakh crore (the biggest in the past decade). Changes in customs duty reduced on import of certain inputs for mobile phone

manufacturing, shrimp feed etcand increased on cigarettes, gold articles, compounded rubber etc. Capital outlay for the railways increased to the highest ever of Rs 2.40 lakh crores. An outlay of Rs 19,700 crores has been allocated to the National Green Hydrogen Mission to facilitate transition of the economy to low carbon intensity, reduce dependence on fossil fuel imports, 100 labs for developing applications using 5G services will be set up in engineering institutions to develop a new range of opportunities, business models, and employment potential, outlay for PM Awas Yojana is being enhanced by 66% to over Rs 79,000 crore, 50 additional airports, heliports, water aerodromes and advanced landing grounds will be revived for improving regional air connectivity, 100 critical transport infrastructure projects, for last and first mile connectivity for ports, coal, steel, fertilizer, and food grains sectors have been identified and will be taken up on priority with investment of Rs 75,000 crore, including Rs 15,000 crore from private sources.

Focus on Agriculture

Digital Public Infrastructure for agriculture will be built as an open source, open standard and interoperable resulting in Inclusive farmer-centric solutions, Relevant information services for crop planning/health, Better access to farm inputs, credit, and insurance, Growth-support of the agri-tech industry and start-ups, Funding for Agri-startups, Agriculture Accelerator Fund will be set-up to encourage agri-startups by young entrepreneurs in rural areas, Agriculture credit target to be increased to Rs 20 lakh crore with focus on animal husbandry, dairy and fisheries. A new sub-scheme of PM Matsya Sampada Yojana with targeted investment of Rs 6,000 crore to be launched for fishermen, fish vendors and MSMEs, set up ofmultiple cooperative societies in uncovered villages over the next 5 years.

Horticulture: Atmanirbhar Clean Plant Programme will be launched to boost availability of disease-free, quality planting material for high value horticultural crops at an outlay of Rs 2,200 crore.

Millets: To make India a global hub for 'Shree Anna' (Millets), the Indian Institute of Millet Research, Hyderabad will be supported as the Centre of Excellence for sharing best practices, research and technologies at the international level.

Hindenburg report and Adani group

Gautamadani is one of the most popular billionaires in the world because of its very fast wealth generation capability. Several companies of Gautamadani is listed on stock exchange such as adani enterprise, adani transmission, adani wilmar, adani total gas, adani green energy, adani ports and adani power, Ambuja cement and ACC. All these companies are involved in various business such as airport, ports, electricity generation and transmission, FMCG etc. all these companies stocks has created huge amount of wealth during last two to three years but now all these stocks are drowning to their depth because of an American agency named Hindenburg. they put forward a report regarding all these companies that they are in heavy debt, they are involved in money laundering, they don’t have transparency in their account, etc. and Hindenburg group itself has shorted Adani group companies bond in U.S. market. Due to this all stocks traded in Indian market has seen decline upto 60 %. Since the beginning of this run all these stocks are not fundamentally very strong once adani enterprises PE ratio soared to 500. The P/E ratio is one of the most used metrics in order to know the true valuations of a company. It simply represents how much money investors are willing to pay per rupee of earnings. In other words, a P/E ratio of 10 means, investors have to pay INR 10 for INR 1 rupee of earnings by the company. Hence, the

lower this ratio, the lower would be the valuation of the company and vice versa. When Adani Enterprises included in the benchmark Nifty 50 index by replacing Shree Cements, prior to its inclusion in the index, the stock has become extremely expensive. The valuation of the company is skyrocketing on the back of a relentless rally, making stock the most expensive in the index, and that too by a 'huge margin'. In FY22, the company reported a 74.8% YoY growth in net revenue to INR 70,432.69 crores. However, net income tanked 15.8% to INR 776.56 crores in the same period. In fact, the company's net income has declined at a yearly rate of 4.7% over the last 5 years, although during the same period the revenue has grown at a yearly rate of 13.52%.The problem is while the revenue has been increasing, the company is struggling to improve its operational efficiency and hence profit figures have remained subdued. The primary reason for this deviation is the excessive leverage at which the company is operating. As of FY22, the total liabilities in the books of the company were around INR 74,657.99 crores. But more importantly, liabilities soared over 172% since FY19, when the company had INR 27,392.47 crores worth of liabilities in the books. At present SBI has a exposure of around 27000 crore PNB has a total exposure of around 7000 crore and BOB has a total exposure of about 5380 crore and furthermore LIC has disclosed holding of 36,474.78 crore in Adani group.

Adani Enterprises has been going quite aggressive in its expansion plans, but the amount of debt taken for expansion is becoming a hindrance as obligations to service debt is taking a toll on the net profit figures. In fact, you'll be surprised to know that the company is operating at a net profit margin of a mere 1.1% (as of FY22), falling further from 2.29% in FY21. The EPS of FY22 was recorded at 7.06. Still, there has been a relentless demand for the stock, primarily on account of mandatory buying from index funds that are invested in the Nifty 50 index. The P/E ratio of the company has soared to 504.3, which is mind-boggling but now after the crash of adani enterprise, stock has a PE of 176.42 which is still highest in the Nifty 50 index.

Key points of Hindenburg Research on Adani Group

1. **Overvalued shares** – Hindenburg's analysis claim that the Adani shares are highly overvalued by conventional metrics such as P/E Ratio, Price/Sales ratio and EV/EBITDA. Some of the extreme cases include the P/E Ratio of Adani Enterprises being 42 times the industry average and the Price/Sales ratio of Adani Total Gas being 139.3 times the industry average of 1.0x etc.
2. **Debt-fuelled business** – This means that the total amount of current assets is less than the total amount of current liabilities in these companies. This is not a healthy financial practice as this means that the companies are unlikely to have adequate assets to pay off their liabilities in the short run.
3. **Promoters pledging their stocks** – This means that the promoters of the company have taken on additional debt on the basis of the shares that they own. As seen above, the share prices are claimed to be already high and so is the debt – therefore, promoters pledging stocks to take on more debt is not a healthy financial practice in such a context.
4. **Doubts regarding the management team** – The report claims that some members of the management have a questionable past which includes allegations of fraud, duty evasions, and scams and also money laundering.
5. **Excess promoter control of shares** – It has been alleged that in addition to the already high proportion of promoter holding in shares (close to 74% in multiple cases), significant portions of the remaining public shares are also controlled by shell companies that have ties with the Adani group such as mutual fund house in Mauritius. Many of these

companies have a large majority of their shares invested solely in firms under the Adani Group. This refers to that in practical terms, that these companies may have worked their way around the SEBI mandate that requires at least 25% of the shares of a listed company to be in public shareholding. This exposes these companies to a high risk of being delisted.

6. **Pumping of shares** – The preceding point also hints at deliberate pumping of the Adani stock prices through excessive buying pressure from companies that seem to be biased towards (or perhaps connected with) the Adani Group itself. It is claimed that the delivery volume of Adani stocks may have been high because of possible wash trading (ie. buying/selling of a share by the same or related entities to pump up the trading volume numbers). Rumors regarding the involvement of the noted stock manipulator Ketan Parekh have also been raised in the Hindenburg report.

Effect of this report on Adani group

- Citibank Inc. wealth arm announced to stop accepting Adani Group's bonds as collateral for margin loans and ramped up scrutiny against the company's financial conditions.
- Citibank Inc. is the second agency to stop accepting Adani bonds as collateral. Before them, Credit Suisse said that following a steep decline in the value of Adani group bonds, it has stopped receiving those as collateral for margin loans.
- LIC, one of the primary investors in the Adani Group, also said to inquire with the company regarding the allegations made in the Hindenburg report. LIC is quoted as saying that as an investor, it has every right to inquire about the said fraud.
- Following the series of events, the RBI directed local banks to update the details of their exposures in the Adani group of companies

Conclusion

According to prominent economist this budget will not give any benefit to middle class people, neither the sky rocketing prices of goods and commodities are in control, neither the people will get any direct benefit from the budget. 2.40 lakh crore has been granted to railways but ticket prices is still not reduced. Petrol, diesel, CNG and LPG prices are higher than ever but no signal of cutting down of its prices reflected in a budget, but government is hoping for strong recovery in Indian and global economy, also many bankers and mutual fund houses such as J.P. Morgan, Morgan Stanley, Black Rock and Credit Suisse has warned about global recession which will envelope the global economy till the end of 2023.

Six to eight months earlier similar reports came from Mauritius, that two mutual fund houses in Mauritius associated with Gautamadani are involved in active trading of Adani group stocks and they are manipulating the stock prices, after spreading of this news share price of all Adani group companies started to hit lower circuit. But at now after the Hindenburg report the situation is even more serious, adani green and adani transmission shares have eroded their gains by 70 % as of 13 February and other companies such as adani enterprises, adani total gas and adani ports have washed away 60 % of their gains. Due to sharp fall in adani enterprise share adani group has called off their 20000 crore FPO whose upper band price limit was 3276.

According to DRHP papers, out of these 20000 crore 10000 crore will be used for repaying of loans. According to analyst they shouldn't call off their FPO as they need more fund and liquidity to pay their debts.

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SUSTAINABLE AND ECONOMIC CULTIVATIONOF MEDICINAL MUSHROOM

Nivedita Singh*[1] and Savita Jandaik[2]

[1]Ph. D. Scholar, Dr.Y.S.Parmar
University of Horticulture & Forestry
Nauni, Solan, HP -173211
[2] Assistant Professor, Dept. of Plant Pathology
Dr.Y.S.Parmar University of Horticulture & Forestry
Nauni, Solan, HP -173211
*Corresponding author: nivedita716@gmail.com

Introduction

In the present scenario, looming health crises are anticipated because of the prevalent use of chemicals in food, large quantities of agricultural waste and regularly changing climate. The cultivation of macroscopic edible fungi is a controlled process of conversion of agro industrial lingo-cellulosic waste and residues to highly nutritious food. Itis a very adequate example of sustainable farming and has several benefits. The Blue Oyster (*Hypsizygusulmarius)* is one such mushroom, also known as the 'Elm Oyster Mushroom' which is cultivated all over the world majorly in Asia and Europe.It is easy, inexpensive and has high biological efficiencyon the agricultural waste unlike the common button mushrooms. It is a novel species with very large fruiting bodies and blue coloured pinheads which become light white on maturity. It also appears to be a good source of vitamins, minerals and proteins and also possess various medicinal properties. The protein in mushroom is better than most types of nourishment, including milk and contains all the essential amino acids required by man. Mushroom cultivation reuses agro-residues that would otherwise be burned in fields or piled up in landfills. There are several options for using agricultural residues as substrate or supplements in mushroom cultivation which India, being an agriculture based country has in abundance. The type of substrate used depends on the availability in the particular region. These wastes are essentially resources and mushroom farming utilizes them to its advantage. Blue oyster mushroom, as an indoor crop, use vertical space and require only 25-30 litres of water to produce one kilogramme of mushroom, providing a solution to shrinking agricultural land and water (Kumar et al., 2019) . Its cultivation can play an important role in increasing food security and diversifying employment opportunities.

Nutritional Benefits

Mushroom utilization in food and medicine has been an age-old practice in different civilizations, due to its appetizing taste and dietetic qualities. Mushrooms use their enzymes to degrade and decompose the complex food materials present in the biomass where they grow (Nwoko, 2017). Oyster mushrooms are one such medicinally and nutritionally valuable species. It also contains a wide variety of biologically active compounds with therapeutic properties. The protein content is about 21-24 %, carbohydrates 31-39 % and 15-20 % fiber (Cyriacus et al*.,* 2020; Kumar, 2019). It has numerous medicinal properties such as, antifungal, anti-inflammatory, antitumor and anti-oxidant. Its polysaccharides possess properties that can protect the biological system from

oxidative stress through its antioxidant activity and therefore have a substantial hepato-protective effect (Govindan et al., 2021).

Cultivation

Blue Oyster Mushroom was introduced for commercial production for the first time in India by IIHR. Mushrooms are initially gray in colour, fading on maturity. Gills and stalks are white. The fruit bodies are enormous and borne in clusters and have a shelf life of 36-48 hours at 25-30°C. Pinhead initiation begins after 4-7 days of opening of the bags and matures for harvest within 2-3 days. The total cropping cycle is 37-42 days from spawning to harvesting. The average biological efficiency of 80-90% can be obtained within this period. It can be marketed as fresh, dry or as mushroom powder (IIHR, 2022). It can be easily grown on variety of substrates like wheat straw, paddy straw, soybean, maize straw, sugarcane bagasse, etc. and other agro-wastes can be used as supplements in the cultivation like apple pomace, cotton seed meal, banana leaves, water hyacinth, lemon grass, etc. The spawn is generally prepared on wheat grains but a variety of other grains have shown promising yields like bajra, sorghum grains, etc.

The substrate sterilization by hot water treatment of straw has appeared to be very effective, low cost technique and one that can easily be performed by the farmers. The straw is chopped into smaller lengths of 4-6 cm and soaked in water for 10-12 hours. Thereafter the pre-soaked straw is boiled in water for 1 hour at 100°C (Kalita, 2015) and cooled on a clean metallic sieve. This substrate is filled in polypropylene bags and spawning is done. There are two methods i.e. layered spawning and through spawning at the rate of 4 % on wet weight basis. After spawning, the upper ends of the bags are tied with the help of nylon strings. 8 to 10 holes of 1 mm are made in each bag for ventilation. The spawned bags are kept in mushroom house. The average temperature 20-30°C, pH7.0-8.0 and relative humidity 75-90% is required for proper growth.

The mushroom mycelium completely colonizes the substrate in about 18-20 days after which the polypropylene bags are removed. Further, in order to maintain the required moisture regular watering is done as mist spray. The pinheads start appearing after 3-4 days of removing the bag. Blue oyster fruiting bodies appear in clusters which starts appearing after 6-7 days of pin head initiation. The fruiting time and interval can vary with the prevalent climatic conditions and substrates used. There are about 3-4 flushes and the fruit bodies are picked just before the edges of the pileus begin to curl downwards by a gentle twist and pull technique of the fruit body. The use of hot-water treatment @ 4 % spawn on wheat and paddy straw gives a biological efficiency of 75-85% and addition of supplements has been shown to increase yield significantly.

Conclusion

In India, where there is only a little diversity in terms of the commercially cultivated mushrooms the Blue Oyster Mushroom has a fair potential of providing economic returns and appear as a good nutrition source. In addition to the good yield and easy, cost-effective cultivation technique it also is a convenient way of recycling the agricultural farm waste.

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Official Address :
Peshok Tea Estate
P.O.- Peshok, Dist.- Darjeeling
West Bengal, India
PIN-734312

Contact No : +91 7501389678
email : agriindiatoday@gmail.com