ISSN : 2582-6344
Volume - 3, Issue -1

Times of Agriculture

A Resonance in Agriculture

Monthly Agriculture E-Magazine

January-2023

MILLETS

"Marvel Grain of Future"

Timesofagriculture.in

FROM THE EDITOR'S DESK

With the beginning of the new year, **Times of Agriculture e-magazine** starts with new enthusiasm and publishes issues full of information for readers, hope you support and show love like in the past years.

This issue is based on the **International Year of Millets**, in which all the information related to millets has been included by various scientists and researchers.

Till now these grains were far from the mainstream of the farmers as well as unable to convey their importance to the consumers, but by declaring the year **2023** as the **International Year of Millets**, the UN has decided to attract the attention of the world towards the importance of coarse grains.

Our aim is to provide you with complete information about the trending topic, yet if readers see any kind of deficiency, then must inform us so that it can be improved in our upcoming issues.

Best wishes to all of you for the new year 2023.

Dr. Devraj Singh
Editor-In-Chief

Times of Agriculture

A Resonance in Agriculture

ISSN : 2582-6344

Monthly Agriculture e-Magazine

Dr. Devraj Singh

Editor-In-Chief

Assistant Professor,
Invertis University, Bareilly (U.P.)

EDITORIAL BOARD

Dr. V. P. Pandey

Ex. Dean
College of Horticulture & Forestry, ANDUAT, Ayodhya, U.P.

Dr. Hari Har Ram

Renowned Veg. Breeder and Author
Consultant at Tata Trust-Agriculture Development

Dr. P.D. Meena

Principal Scientist
(Plant Pathology)
ICAR-DRMR, Bharatpur, Rajasthan

Dr. Dhirendra Singh

Sr. Spices Breeder
SKN Agriculture University,Jobner, Rajasthan

Dr. Ajit Kr. Singh

Senior Scientist
(Plant Pathology)
Research Station IGKV, Raigarh, Chhattisgarh

Dr. Ashok Yadav

Scientist (Fruit Science)
Dr. YSPUHF, Solan, Himachal Pradesh

Er. Gopal Carpenter

Scientist
(Farm Machinery & Power)
ICAR- CISH , Lucknow, U.P.

Dr. Laxman Singh Rajput

Scientist (Plant Protection)
ICAR-Indian Institute of Soybean Research Indore, Madhya Pradesh

Dr. G.C. Yadav

Professor & Head
CHF
ANDUAT, Ayodhya, U.P.

Dr. Bhanu Pratap

Associate Professor
(Fruit Science)
ANDUAT, Ayodhya

Dr. Arun Alfred David

Associate Professor,
Soil Sci. and Agril. Chem.
SHUATS, Prayagraj, U.P.

Dr. Sudhir Kr. Sahi

Associate Professor,
Dairy Technology,
U.P. College,Varanasi, U.P.

Dr. A.K. Singh

Professor
Soil Science & Agril. Chemistry, P.G. College, Ghazipur, U.P.

Dr. Ashutosh Sharma

Assistant Professor,
Agricultural Extension & Communication,
RLBCAU, Jhansi, U.P.

Ms. Bandana

Scientist (Fruit Science)
Dr. YSPUHF, Solan, Himachal Pradesh

Dr. Govind Vishwakarma

Research Associate,
Fruit Science,
RLBCAU, Jhansi, U.P.

Dr. Sandeep Rout

Assistant Professor, Forestry,
Sri Sri University, Cuttack, Odisha

About us

"Times of Agriculture" is a monthly agriculture e-Magazine initiated for the purpose of providing information about recent innovations and technologies in agriculture and allied sectors. This e-Magazine gives a platform to dignitaries like scientists, researchers, scholars, students and innovative farmers to share their views and vivid ideas about agriculture. The main objective of this e-Magazine is to provide an open access platform for authors to get on the soapbox and spread awareness regarding the technologies and awareness in agriculture sector by e-publishing articles addressing the upcoming needs in the field agriculture.

Price – *Free for Readers*

Times of agriculture is absolutely free for reader, fee will be payable for members only.

Management Team

Managing Editor

Manager | Editing

Dr. Nishakant Maurya

Editors

Writing | Editing

Dr. Devesh Tiwari
Dr. Vipin Kumar Maurya

Founder

Technical | Design

Mr. Aman Kumar

REVIEWERS

Agronomy

Dr. Ravikesh Kr. Pal, Rama University, Kanpur

Vegetable Science

Dr. Sharvan Kumar, Invertis University, Bareilly
Dr. Mahendra Kr. Yadav, Jaipur National Uni., RJ

Fruit Science

Dr. Shashibala, U.P. College, Varanasi

Floriculture

Dr. Ragini Maurya, BHU, Varanasi
Dr. Sachi Gupta, CSIR-NBRI, Lucknow

Soil Science

Dr. Bharat Lal, RLBCAU, Jhansi
Dr. Kr. Anshuman, KNIPSS, Sultanpur
Dr. Sandeep Kr. Diwakar, Invertis Uni., Bareli

Genetics & Plant Breeding

Dr. Ashish Sheera, SKUAST, Jammu

Plant Pathology

Mr. S.S. Patel, BHU, Varanasi
Dr. Vikash Kumar Yadav, Invertis University, Bareilly
Mr. Shubham Mishra, JNKVV, Jabalpur

Biotechnology

Dr. Vishwajeet Yadav, SVPUAT, Meerut

Extension Education

Dr. Kevin Christopher, ITM University, Gwalior

Entomology

Dr. Ankur Prakash Verma, SVPUAT, Meerut
Dr. Anuj Shakya, SRMU Lucknow

Remote Sensing

Mr. Shivam Pandey, RSAC, Lucknow

Home Science

Ms. Garima Dwivedi, SHUATS, Prayagraj

CONTENT

Cover Story

Millets: Marvel grain of future

Disclaimer: Whatever articles are published in each issue of the Times of Agriculture are sent by different authors, these are their own views of those authors, we just publish these articles in the magazine and bring them to you. Although we are well read and tested while selecting the article, but we do not make any changes in the information given by any author, so the author will be responsible for any mistake in the article, no responsibility of the magazine Will be. We select only good and quality articles, the author will be responsible for the authenticity of the article, not the magazine.

AGRICULTURE UPDATES

First smart mobile composting unit

Minister for Local Self-Governments M.B. Rajesh was inaugurating the **first smart mobile composting unit** in **Kerala** jointly launched by Suchitwa Mission and the Kerala Mission at Pallithottam.

The unit can process up to **500 kg of waste per hour** and convert it into manure.

Forest department launched Project 'Vanikaran' in Kerala

The Forest department in association with **Noolpuzha grama panchayat** has launched the **'Vanikaran' (afforestation)** project to root out invasive plants, especially Senna spectabilis and restore natural forests.

The project was being executed on 30 hectares of forestland under the Sulthan Bathery forest range of the Wayanad Wildlife Sanctuary where exotic invasive plants, including *Senna spectabilis*, *Eupatorium* etc. were posing a serious threat to the local species of trees.

First In vitro fertilization (IVF) mobile unit for animals

India got its first In vitro fertilization (IVF) mobile unit for animals in Gujarat's Amreli. The **mobile IVF lab** was inaugurated by union minister Purushottam Rupala.

“This is India's first IVF mobile unit”. With the help of this unit the work of providing IVF technology to the cattle rearers of Amreli.

The IVF mobile van was "dedicated in a joint venture of the **Government of India** and **Amar Dairy.**

Meghalya tops state in average monthly income per agriculture household

Meghalaya tops across the country with average monthly income per agricultural household **(Rs. 29,348)** followed by **Punjab with Rs. 26,701** and **Haryana with Rs. 22,841.**

Jharkhand has reported the lowest monthly income in agriculture households of **Rs. 4,895** followed by Odisha with **Rs. 5,112** and West Bengal with **Rs. 6,762.**

Agriculture Ministry Organises Millet Food Festival in Parliament

To raise awareness about the importance of millet, Agriculture Ministry is hosting a Millet food festival in Parliament for the members. As the global agrifood systems face challenges to feed an ever-growing global population, resilient cereals like millet provide an affordable and nutritious option.

Food and Agriculture Organization of the United Nations, organized an opening ceremony for the International Year of Millets - 2023 (IYM-2023) in Rome, Italy.

ICAR- IARI developed new chickpea variety Pusa JG-16

Indian Council of Agricultural Research (ICAR)-IARI, in collaboration with JNKVV Jabalpur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior and ICRISAT Hyderabad have developed drought hardy and higher yielding chickpea variety **'Pusa JG 16'.**

"Pusa JG 16 variety was developed by using genomic assisted breeding techniques that allowed precision transfer of drought tolerant genes from **ICC 4958** in the **parental variety JG 16.**

Dharti agro launched world's 1st GM cowpea

Dharti Agro Chemicals Pvt. Ltd is the first in the world to launch a GMS based **Cowpea Hybrids** in the market. It has released three hybrids in Cowpea – Bubbly, Sherly and Poorvaja.

It has given up to **100% heterosis** in the regular season of Kharif and up to 200 to 250% heterosis in off season providing almost two times the profit as compared to the traditional varieties.

MoU to develop the Krishi-Decision Support System (Krishi-DSS)

Department of Space and the Department of Agriculture and Farmers Welfare signed an MoU to develop the **Krishi-Decision Support System (Krishi-DSS)** to enhance the decision-making capability of agriculture sector stakeholders.

It will enhance the decision-making capability of agriculture sector stakeholders through integration with ***BHUVAN (Geo-platform)*** and ***MOSDAC*** of systems of ICAR and ISRO.

Palm leaf Manuscript Museum

Kerala Chief Minister Pinarayi Vijayan has inaugurated the **Palm leaf Manuscript** Museum at the renovated **Central Archives, Fort** area in Thiruvananthapuram, Kerala.

The Museum promoted as **"World's First Palm-Leaf Manuscript Museum"** was set up by the Archives Department in association with the Kerala Museum of History and Heritage at a cost of Rs. 3 crore.

MoU signed for production of 'Goat Pox Vaccine' and 'Lumpi-ProVac' vaccine

An MoU for production of Goat Pox vaccine and "Lumpi-ProVac" vaccine was signed in Nagpur on **29th December, 2022.**

Lumpy-ProVac for LSD is ICAR developed indigenous vaccine.

Lumpi-ProVacind is used for the prophylactic immunization of animals against Lumpy Skin Disease, which illicit protection for about one year.

COVER STORY

MILLETS

"Marvel grain of future"

About the Author

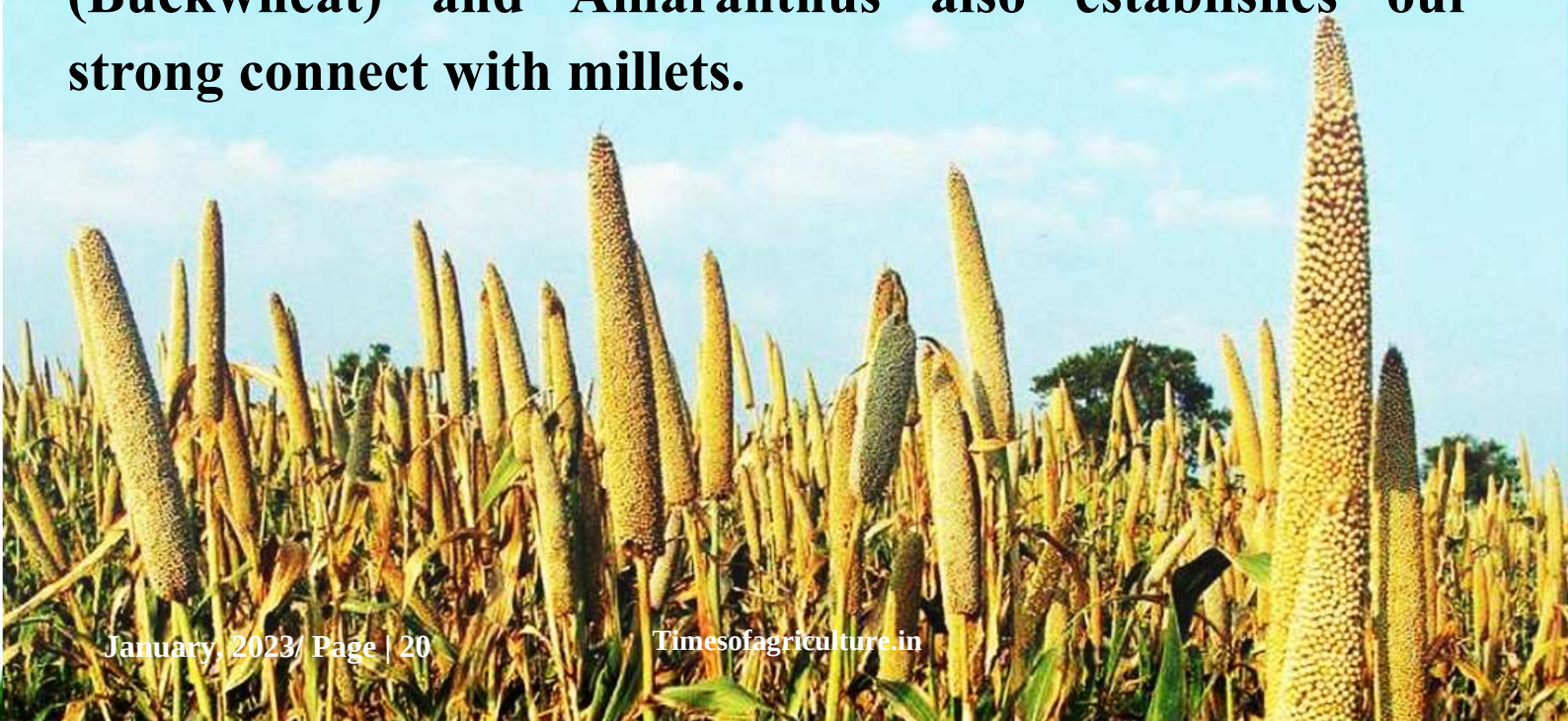
Dr. Mudita Verma

Assistant Professor, *Department of Agriculture*
Invertis University
Bareilly, Uttar Pradesh

INTERNATIONAL YEAR OF
MILLETS
2023

A matter of great pride that on the behest of Government of India under the Prime Ministership of Mr. Narendra Modi Ji and support of 72 countries at 75th session of United Nations General Assembly, year 2023 is declared as *International Year of millets*.

World is celebrating the millets on their plate and palates and we Indians are witnessing the millets comeback again as we had been already associated with the millets long ago. As per our Sanatan Dharma literature, **millets contain 50%, 30%, 20% of the Sattva, Rajasic and tamasic characteristics which shows its connect with spirituality as well.** Our rituals and the diets that has been **consumed on the fasting days includes millets like kuttu (Buckwheat) and Amaranthus also establishes our strong connect with millets.**



Why we are Celebrating 2023 as International year of Millets ?

IYM 2023 will lead India towards Food and Nutritional Security. Millets are considered **'Smart Food' as they are easy to cultivate, mostly organic and contains high nutritional value.** The IYM 2023 celebration is **an opportunity for India to promote Nutri-cereal Millets globally and place them in the world's 'food map' with PM Modi's vision of *"Vasudaiva Kutumbakam" (The World is One Family)* and to make IYM 2023 a *'People's Movement'* alongside positioning India as the *'Global Hub for Millets'*.**

Across the globe we are entering into a new paradigm shift associated with our diet patterns, climate change as well as in the terms of new trading trends of millets. We are celebrating **Year 2023 as the comeback of millets again to our farm and plates with the aim to create awareness, increase production & consumption of millets**. **Raising awareness to create 'Millet Mindfulness' is an essence of this celebration.**

Millets Map of India

Source- National Conference on Kharif Campaign, 2022

IYM 2023 will provide us with a unique opportunity to give visibility to crops that have great potential to strengthen global nutrition, food security, decent jobs & economies, while accelerating climate action. Millets are basically Asian crops, climate resilient, lead to sustainable development and help ensure Food Security & Nutrition for all.

Millets: Solution to Agrarian and Nutrition challenges

Millet is a crop of family **Graminae (Poeceae)** that can survive in ***semi arid zones*** and require less water for irrigation which will also help us in water management. Three well-known recognized crops for its resiliency to extreme weather conditions are **Quinoa, Millet and Sorghum.**

Major Millets

Sorghum
Pearl Millet
Finger Millet

Minor Millets

Foxtail millet
Kodo millets
Barnyard millet
Little millet
Proso millet

Pseudo Millets

Amaranth
Buckwheat

718 Lakh ha
Global Area Under Millets

863 Lakh ton
Global Millets Production

138 Lakh ha
Indian area under Milltes

173 Lakh ton
Indian Millets Production

Crop	Production (Lakh ton)
Jowar	47
Bajra	108
Ragi	19
Small Millets	3.5
Total Nutri Cereals	173

Source- National Conference on Kharif Campaign, 2022

Benefits of millets

Millets are also known as nutri-cereal as they are very high in their nutrition content. Compared to rice, they have 30 to 300% more nutritional elements such as Calcium, Minerals, Iron, Fibre, Beta Carotine and many other micronutrients. Millets are ***rich in B vitamins, calcium, iron, potassium, magnesium, zinc, they are gluten-free and has low-GI (Glycemic index) thus millets are suitable for people allergies/intolerance of wheat***. Diabetic persons and people suffering from weight gain can also opt for millets.

The phenolic properties found in millets compromise phenolic acids, flavonoids, and tannins, which are beneficial to human health.

Pearl Millet : Bajra

Pearl Millet is a super food it helps in reducing cholesterol, high sugar levels, aids in weight loss, relieves constipation, prevents insomnia, best plant based protein source, high in antioxidants, treats iron deficiency anaemia.

Finger Millet : Ragi

Finger millet is full of dietary fiber, which helps to control the "bad" cholesterol that can contribute to heart diseases like atherosclerosis. Soluble fiber absorbs cholesterol before it enters your bloodstream, maintaining a lower cholesterol level.

Foxtail Millet :Kakun

Foxtail Millet is rich in Vitamin B_{12} which is essential for maintaining a healthy heart, smooth functioning of the nervous system, and in general good for skin and hair growth. Foxtail Millet may improve glycemic control and reduce insulin, cholesterol.

Sorghum : Jowar

Gluten-free, rich in fiber, great food for diabetics, source of protein, packed with essential minerals, promotes the health of bones, lose weight, preserves the health of digestive system, source of proteins, rich in antioxidants, and more sustainable than other grains.

Kodo Millet : Kodo

Being naturally rich in fiber, millets also help to reduce problems like constipation, flatulence, bloating and stomach cramping. Millets are a good source of magnesium which is known to be promoting heart health. It helps to reduce blood pressure.

Proso Millet

Proso millet has multiple benefits when consumed as human food. Proso millet is rich in minerals, dietary fiber, polyphenols, vitamins and proteins. It is gluten-free and therefore, ideal for the gluten intolerant people. Proso millet contains high lecithin which supports the neural health system.

Barnyard Millet

Low in calories, rich in dietary fiber, low glycemic index, gluten free grain, good source of iron.

Little Millet

Little millet is rich in Magnesium which helps improve heart health. It is also rich in Niacin which helps lower cholesterol. Little millet contains phosphorus which is great for weight loss, tissue repair and energy production after strenuous workout. It also helps detoxify the body.

Buck wheat

Boosts heart health, improves digestion, helps in weight management, lowers blood sugar level.

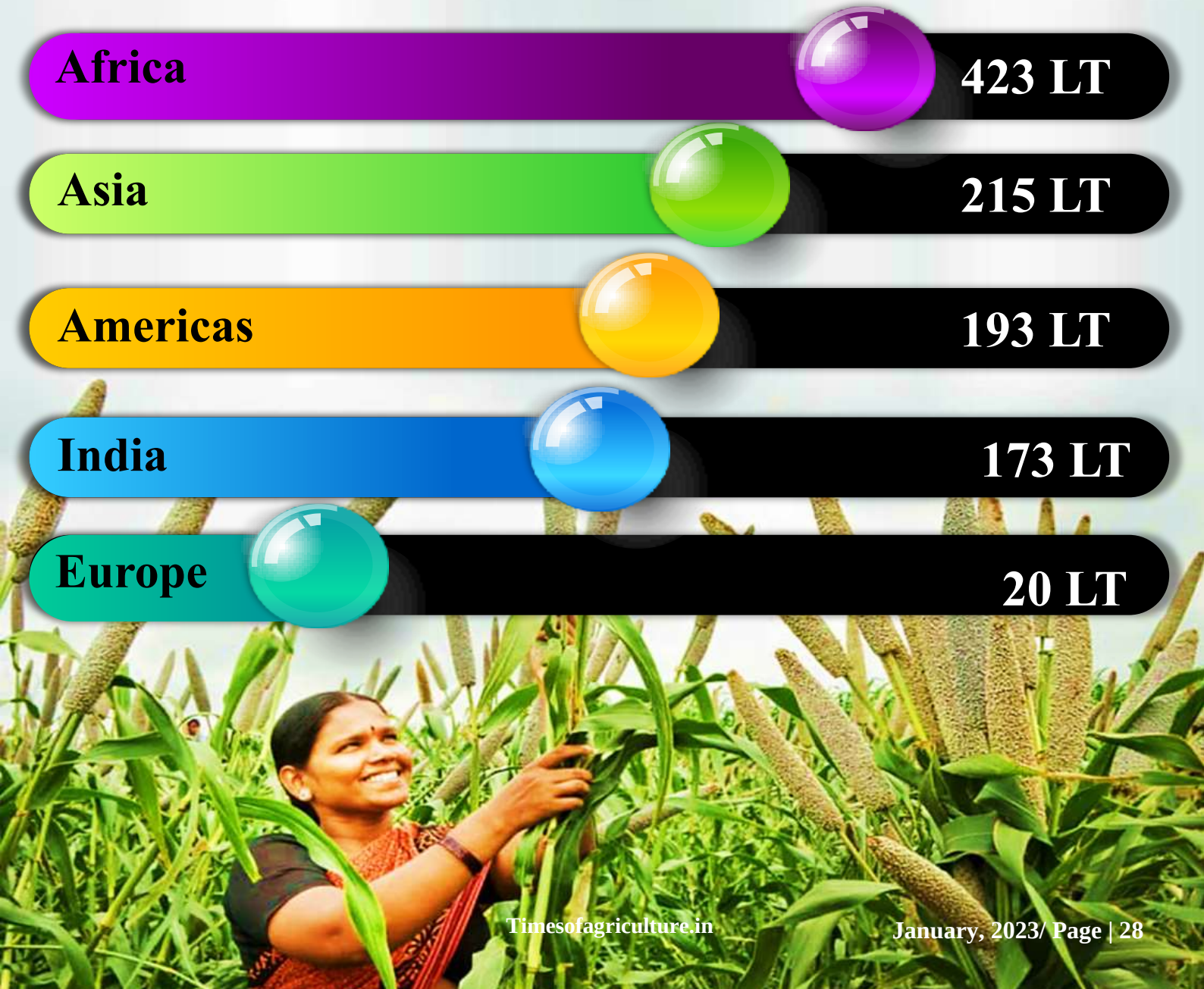
Amaranthus

Amaranth is rich in antioxidants, including gallic acid and vanillic acid. Antioxidants help fight free radicals, which are damaging byproducts of normal cellular activity, helping to reduce everything from signs of aging to heart disease.

India produces >170 lakh ton (80% of Asia's & 20% of global production).

India is among the top 5 exporters of millets in world. World export of millet has increased from $400 million in 2020 to **$470 million in 2021** (ITC trade map). **India exported millets worth $64.28 million in the year 2021-22,** against **$59.75** million in 2020-21. Share of Millet based value added products is negligible.

Global Scenario of Millets



Marvelous Millets Recipes

1 Millets Pasta.

5 Ragi Flakes

2 Multi Grain Millets Sweet Mix (Halva)

6 Ragi Murukku Mix.

3 Muffins (Ragi & Bajra)

7 Ragi Pappad

4 Nutritious Millet Flour.

8 Germinated Ragi Drink Mix

Millets are resilient to **environmental stress, pests, and illnesses, making them a sustainable food supply to fight hunger in a changing world.** Millets are also a long-term alternative for halting climate change and creating climate-resilient agri-food systems because they don't need a lot of water or other resources.

Iron, folate, calcium, zinc, magnesium, phosphorus, copper, vitamins, and antioxidants are all concentrated in nutri-cereals. Dietary fibre is abundant in millets. Along with being essential for children's proper growth and development, they have been demonstrated to reduce the risk of heart disease and diabetes in adults.

Millets are good for **diabetics** because they **don't contain gluten and have a low glycemic index.** They can also help prevent **cardiovascular disease** and nutritional deficiencies. ■

MILLETS
Underrated Powerhouse of Nutrients

Millets offer twin advantages of addressing both production and consumption demands relevant to the country today. The millets are highly suited to poorly endowed production ambience as they are low in water footprint and therefore **suited to arid regions requiring as low as 300 to 400 mm of water.** Besides they are crops of short duration maturing within **60 to 90 days**. Millets are resource-use efficient and respond well to good agronomic conditions. **They are climate-resilient, exhibit hardiness and are highly adaptable under critical drought conditions**. The millets besides being nutritively good for human consumption, are also a nutritious fodder as they are **rich in iron, magnesium, copper, phosphorous zinc, calcium and potassium.**

About the Author

Sharad Shikandar Jadhav

Ph.D Research Scholar

Mahatma Phule Krishi Vidyapeeth

Rahuri, Maharashtra

Distribution of Millets in India

India is the top most producers of millets followed by Nigeria for the year 2000 and 2009. In India, **eight millets species** are commonly cultivated **under rainfed conditions.** For instance, while **Pearl millet and sorghum are primary crop and allied crops respectively in the desert regions of Rajasthan,** in the eastern parts of Rajasthan and Gujarat it is the opposite. Similarly, **sorghum is sown as major crop in the Telangana, Andhra Pradesh, Maharashtra and parts of Central India**. Likewise, Finger millet is a primary crop in **Tamil Nadu and Gujarat**, while the same is a minor crop in **Telangana**. Hence, the spatial distribution of millets either as a primary crop or as allied crops largely depends on the growing habitat and the amount of rainfall the region receives. Further, the small millets are found in most of the southern and central states in India.

The **International Year of Millets**, therefore, stands to provide a unique opportunity to increase global production, ensure efficient processing and consumption, promote a better utilization of crop rotations, and encourage better connectivity throughout food systems to promote millets as a key component of the food basket.

The International Year will

- *Elevate awareness of the contribution of millets for food security and nutrition.*
- *Inspire stakeholders on improving sustainable production and quality of millets.*
- *Draw focus for enhanced investment in research and development and extension services to achieve the other two aims.*

The UNGA adopted the resolution declaring 2023 as the International Year of Millets**. Co-organized by the Permanent Missions of India and of Nigeria to the United Nations, with the support of FAO.**

Health Benefits of Millets

Millets have potential health benefits and epidemiological studies have showed that consumption of millets reduces risk of **heart disease**, **protects from diabetes, improves digestive system, lowers the risk of cancer, detoxifies the body, increases immunity in respiratory health, increases energy levels and improves muscular and neural systems and are protective against several degenerative diseases such as metabolic syndrome and Parkinson's disease.** The important nutrients present in millets include resistant starch, oligosaccharides, lipids, antioxidants such as **phenolic acids, avenanthramides, flavonoids, lignans and phytosterols** which are believed to be responsible for many health benefits.

Specific health benefits of millets

- Offer hunger satisfaction due to the presence of high dietary fiber
- Reduce risk of diabetes and cardiovascular diseases
- Reduce occurrence of hypertension
- Reduce oxidative stress as they are rich in antioxidants detoxify body.
- Reduce anaemia, liver disorder and asthma
- Prevent allergies reactions due to their hypo-allergic properties
- Fiber content in millets helps in eliminating disorders like constipation, excess gas, bloating and cramping.■

CELEBRATING MILLETS - AS NUTRICEREALS FOR FOOD, NUTRITION & HEALTH

Millets have been the oldest foods known to humanity and are the most important group of small grained cereal crops which are highly nutritious and are grown under marginal soils. They were the first crops to be domesticated by the mankind in Asia and Africa which later on spread across the globe as critical food sources to the evolving civilizations. Millets are sometimes referred to as famine crops orphan crops since they are the only crops that assure yields in famine situations and they were the last option for cultivation as they had less demand. Millets were traditionally consumed, but post Green Revolution (1960s), millets were less consumed and slowly forgotten. Before the Green Revolution, millets made up around 40 per cent of all cultivated grains but has come down to around 20 per cent over the years. Not only has the consumption of millets declined, but the area under production has been replaced with commercial crops, oilseeds, pulses and maize. These commercial crops are profitable, and their production is supported by several policies through subsidised inputs, incentivised procurement and inclusion in the Public Distribution System. This has resulted in changes in dietary patterns with preferential consumption towards fine-calorie-rich cereals. India produces all the nine commonly known millets and is the largest producer and fifth-largest exporter of millets in the world. Most of the states in India grow one or more millets. Rajasthan, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, and Telangana are the major millets producing states.

About the Author

Dr. Ashok S. Alur

Director

Centre of Excellence for Farmer Producer Organizations, Government of Karnataka, UHS -Campus, GKVK, Bengaluru

Classification of millets

There are different types of millets. Based on area grown and their grain size, they are classified as (a) Major millets and (b) Minor millets. The major millets include sorghum (jowar) and pearl millet (bajra). The minor millets include, finger millet (ragi/mandua), foxtail millet (kangni/Italian millet), little millet (kutki), kodo millet, barnyard millet (sawan/jhangora), proso millet (cheena/common millet), and brown top millet (korale).

Millets are special

Millets have shorter growing duration and complete their life cycle in 2-4 months, fit wide range of cropping systems and also adapt themselves to the changing environmental conditions especially during vagaries of monsoon. Millets are basically starchy grains and have potential for industrial level production of starches, dextrin and ethanol for food and allied applications. In most of the developed countries, millets find extensive usage as feed components for bird, cattle and pigs. Millets are smart foods, in this era of explosion of availability of super foods, the millets have a unique standing. Millets are very special crops and they are good for the consumers as they can help overcome some of the biggest nutritional and health problems (iron, zinc, folic acid, calcium, diabetes and more). They are good for the planet as they have a low water footprint, are able to survive in the hottest driest climates and will be important in coping with climate change. Millets are good for the farmer as they can increase yields up to 3 fold, have multiple uses (food, fodder, fuel), and are typically the last crop standing in times of drought being a good risk management strategy for farmers.

Health benefits of millets

Due to chaning life-styles and food habits, millets have returned as a viable option to live healthy life and can reduce the incidence of various lifestyle diseases. Millets also have many nutritional, nutraceutical and health promoting properties especially the high fibre content, nature of starch has major role in reducing the risk of diabetes other related diseases. The beneficial effects of millets on human health are being recognized in the post covid period due to enhanced health consciousness among the people. Millets bring variety of health benefits such as,

1. Millets are the health-promoting nutritious crops. As compared to other cereals they have superior micronutrient profile and bioactive flavonoids.
2. Millets have a greater role to play in treating stomach ulcers and gall stones. The regular consumption of millets turns the stomach alkaline and thus prevents the formation of stomach ulcers and will also reduce the impact of ulcers on the human beings.
3. Millets are the best food sources to reduce issues with obesity. Millets contain very high quantities of dietary fibre and intake of high dietary fibre results in hunger satisfaction and increases satiety decreases the incidence of obesity.
4. Millet consumption decreases triglycerides and C-reactive protein, thereby preventing cardiovascular diseases. Regualr consumption of whole millet grains (40g/day) thus help in reducing the risk of Cardio vascular diseases (CVD) and thus reduces the risk of coronary heart disease by 20% .Millet has a beneficial effect on the management and prevention of hyperlipidemia.
5. Anemia is one of the most prevelant health problems in Indian context. Millets are the good sources of natural iron. Consumption of millets can bringdown the anemia in human beings.
6. Regaular consumption of millets will help in keeping malnutrition, degenerative diseases, liver disorders and asthama under control.
7. People suffering from allergic reactions can rely on millets. Pearl millet has a very low probability of causing allergic reactions due to the hypo-allergic property.
8. Millets possess antidiabetic properties. Regular consumption of millets can lower the blood glucose response and glycosilated haemoglobin thus rendering low glycaemic index and thus helps in reducing the risk of diabetes mellitus.
9. Millets have a role to play in reduction of oxidative stress. The phenolic compounds present in the millets removes the free radicals thus reducing the oxidative stress.
10. It is proved that millets also have anticancer properties. The millet extracts have antiprolific effects on cancer cell line, inhibit DNA damage and induce the production of phase-2 detoxifying enzymes.
11. Millets have capacity to prevent the oxidation of low density lipoproteins reducing lipase activity which reduces the occurrence of hypertension.
12. Millets contain various minerals and are the good source of minerals like iron, zinc, and calcium.
13. Millets are gluten-free and can be consumed by celiac disease patients.
14. Millets are found to be helpful with the reduction of weight and body mass index (BMI).

16. In India, Millet is generally consumed with legumes, which creates mutual supplementation of protein, increases the amino acid content, and enhances the overall digestibility of proteins.
17. The millets also act as a prebiotic feeding micro-flora in the human inner ecosystem. Millets hydrate the colon and protect us from being constipated. The high levels of tryptophan in millet produce serotonin, which is calming to our moods. Niacin in millet can help lower cholesterol.

Millets as Nutrition Source

With the advances in modern science, the nutritional characteristics of millets have been discovered. Though it was incidental that millets were the first crops to be cultivated, they were also more nutritious. However, their goodness was not known till biochemical and food and health science studies were carried out in the modern times. Nutritional insecurity is a major threat to the world's population that is highly dependent on cereals-based diet, deficient in micronutrients. Millets are nutritionally superior as their grains contain high amount of proteins, essential amino acids, minerals, and vitamins. Almost all the millets are used for human consumption in most of the developing countries, but their use has been primarily restricted to animal feed in developed countries. Millets are nutritionally comparable to major cereals for carbohydrates/ energy, and serve as good source of protein, micronutrients and phytochemicals. The millets contain 7-12% protein, 2-5% fat, 65- 75% carbohydrates and 15-20% dietary fibre. Millets possess unique nutritional characteristics specifically have complex carbohydrates, rich in dietary fibre as well as unique in phenolic compounds and phytochemicals having medicinal properties. Millets are natural source of iron, zinc, calcium and other nutrients that are essential for curbing the problem of malnutrition in India. They have higher content of niacin, B_6 and folic acid, and calcium, iron, potassium, magnesium and zinc. Finger millet is the richest source of calcium (300- 350 mg/100 g) and other small millets are good source of phosphorous and iron. Millets are easy to digest, contain a high amount of lecithin and are excellent for strengthening the nervous system.

Table-1: Nutrient composition of millets in comparison with wheat and rice

Grain (Millet /Cereal)	Carbohydrates (g)	Protein (g)	Fat (g)	Dietary fibre (g)	Ca (mg)	P (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Folic acid (µg)
Sorghum	67.7	09.9	1.73	10.2	27.6	274	133	1.9	3.9	0.35	0.14	2.1	39.4
Pearl Millet	61.8	10.9	5.43	11.5	27.4	289	124	2.7	6.4	0.25	0.20	0.9	36.1
Finger millet	66.8	07.2	1.92	11.2	364.0	210	146	2.5	4.6	0.37	0.17	1.3	34.7
Kodo millet	66.2	08.9	2.55	06.4	15.3	101	122	1.6	2.3	0.29	0.20	1.5	39.5
Proso millet*	70.4	12.5	1.10	-	14.0	206	153	1.4	0.8	0.41	0.28	4.5	-
Foxtail millet*	60.1	12.3	4.30	-	31.0	188	81	2.4	2.8	0.59	0.11	3.2	15.0
Little millet	65.5	10.1	3.89	7.7	16.1	130	91	1.8	1.2	0.26	0.05	1.3	36.2
Barnyard millet*	65.5	06.2	2.20	-	20.0	280	82	3.0	5.0	0.33	0.10	4.2	-
Wheat	64.7	10.6	1.47	11.2	39.4	315	125	2.8	3.9	0.46	0.15	2.7	30.1
Rice	78.2	07.9	0.52	02.8	07.5	96	19	1.2	0.6	0.05	0.05	1.7	9.32
Amaranth seed	61	13.3	5.6	7.5	162.0	412	270	2.8	8.0	0.04	0.04	0.52	24.7
Quinoa	54	13.1	5.5	14.7	198.0	212	119	3.3	7.5	0.83	0.22	1.7	173
Buckwheat*	72	13.3	3.4	10.0	18.0	347	231	1.0	2.2	0.101	0.43	7.02	-

Source: Indian Food Composition Tables, NIN – 2017; *Nutritive value of Indian Foods, NIN

Initiatives to Encourage Millets Production

The central and state governments have taken up several measures to promote millet production. Some of them include,

1. Millets are being promoted through technology dissemination, quality seeds supply through millet seed hubs, awareness generation, minimum support price and inclusion in PDS.
2. Development and promotion of fortified millets is in progress which can address nutrition deficiency issues.
3. Efforts towards inclusion of nutrient-rich smaller millets in the mid-day meal schemes in government and government-aided schools in Karnataka and Telangana are some examples in this direction.
4. Karnataka organizes international millet fairs to popularise millets.
5. Millet awareness is catching up fast in the urban centres such as Bengaluru, Hyderabad, Chennai, Mumbai, Kolkata, Delhi and other cities.
6. The Union Agriculture Ministry, in April 2018, declared millets as “Nutri-Cereals”, considering their “high nutritive value” and also “anti-diabetic properties”.
7. The UN General Assembly adopted an India-sponsored resolution to mark 2023 as the “International Year of Millets”.
8. The Government of India’s Millet Mission comes under the National Food Security Mission (NFSM), launched in October 2007.
9. The Centre’s Millet Mission will focus on developing farm-gate processing and empowering farmers through collectives while focusing on value-addition and aggregation of the produce.

Way Forward

Millets are emerging as superfoods. There is a need to create awareness about the benefits of millets. Millet farmers are highly unorganized and face several problems.Promoting the production of more millets by providing price support to farmers can come andy to farmers as there's not only a social dimension but also a nutritional and environmental aspect associated with these cereals. Millet farmers need to be organized under Farmer Produecr Organizations to address their challenges. Further there is also a need to encourage a large number of players working on value-added millet products in India. Various reasons behind the decline of area under millets such as low remuneration, lack of input subsidies and price incentives, subsidised supply of fine cereals through the public distribution system (PDS) and change in consumer preferences and lower demand need to be strategically addressed. Focussed attention need to be laid on encouraging proper market linkages for millet production and marketing.There is a need for developing a decentralised model of processing capabilities so that the growers get to benefit at a community level and in the growing regions.Dedicated programmes with capacity-building initiatives that support farmers to move away from loss-making crops toward diversification via millets.The International Year Of Millets is a great opportunity to promote and popularize millets across the globe and we need to join hands in this endaveour.

Acknowledgements:

Thankfully acknowledge the information, data and insights from APEDA, IIMR and AICRP Millets.

DID YOU KNOW?

INTERNATIONAL YEAR OF MILLETS 2023

The millet foods are considered as miracle grains, they are also known as "Siri Dhanya" millets. Siri means wealth, which is indirectly health. As there is an ancient saying HEALTH IS WEALTH.

KNOCK OUT DIABETES WITH INSULIN PLANT

About Author

Ms. Harichandana Ponnapalli*
Ph.D. Research Scholar
Dr. Sarojani J. Karakannavar
Professor

Deptt. of Food Sci. and Nutrition,
College of Community Science,
University of Agricultural Sciences,
Dharwad, Karnataka

What is diabetes?

Diabetes is a long-term metabolic disorder that affects the way the human body metabolizes the primary energy sources namely carbohydrates, fats and proteins. It results in high blood glucose levels, eventually leading to critical health conditions like cardiovascular diseases, and complications associated with kidneys, brain, vision, etc. Diabetes has been significantly increasing in frequency and incidence over the past few decades. Nearly 422 million people with diabetes worldwide live in low- and middle-income countries, where diabetes is directly responsible for 1.5 million fatalities yearly.

A variety of side effects arising due to diabetic drugs are not uncommon. For that reason, many people are shifting towards herbal and folklore treatments as an option. One such ancient plant that could change the game of diabetes is the Insulin plant.

Insulin plant

Native to Southeast Asia, the insulin plant is most prevalent in Indonesia's Greater Sunda Islands. It is relatively a new introduction to India during 2002-03 and ever since it is being used as an ornamental plant in South India. Chewing insulin plant leaves for a month is the traditional method of treating diabetes in the Ayurvedic medical system in order to get a balanced blood glucose level.

The insulin plant is an annual, erect and tropical evergreen plant that grows to a height of around 2 feet. It grows well under full sun or partial shade and usually grown close to the water and requires rich soil and plenty of moisture. Cuttings and splitting clumps or plantlets that grow below the inflorescence are all methods of propagation. When growing plants in a light, sandy soil, mites and nematodes might be an issue. There seem to be no serious illnesses affecting the plant.

Fig 1: Insulin plant

Fig 2: Flower of Insulin plant

Essential nutrients like protein, iron and antioxidant substances such as Vitamin C, Vitamin E, β-carotene, terpenoids, steroids and flavonoids are abundant in the insulin plant. Several research studies have reported numerous health benefits of the insulin plant. Some of these have not yet been verified. The leaf, stem, root and rhizome are among the different plant parts that display these activities. However, an important source of antidiabetic activity is the leaves of the plant.

Antidiabetic effect of insulin plant

The major components responsible for hypoglycemic activity in insulin plant are corosolic acid and diosgenin. The leaf extract containing these components facilitates the opening of voltage-gated calcium channels through which calcium ions can enter into the β-cells of pancreatic islets. This action stimulates the unresponsive β-cells to secrete insulin which acts as the key to allow the entry of glucose into the cell for energy metabolism. This is one of the major mechanisms through which oral hypoglycemic drugs act to reduce diabetes. Apart from this, these components also enhance the expression of certain receptors and transporters for glucose entry into the cell.

How to consume insulin leaf?

The well-known tagline for insulin leaf is "a leaf a day keeps diabetes away". Scientific articles suggest that to obtain the full benefit of this leaf it must be chewed at a rate of two leaves (one in the morning and one evening) per day for one week. Be careful to thoroughly chew the leaves before consuming them. The recommended duration of this dosage is 30 days. This is also advised by allopathic physicians, who have been shown to be successful in bringing blood sugar levels entirely under control.

Side effects of insulin plant leaf

The insulin plant can also result in difficulties and adverse effects such as nausea, diarrhoea, and dizziness. Therefore, before taking this or any other supplement, it's crucial to see your doctor. More research is required to prove the safety and efficacy of incorporating this leaf into your lifestyle, even though it might have some potential advantages.■

Sandeep Gawdiya

Ph.D. Student
Division of Agronomy
ICAR-IARI, New Delhi

CROP DIVERSIFICATION

TO MITIGATE BIOTIC AND ABIOTIC STRESS FOR LONG-TERM FARM SUSTAINABILITY

Agriculture is one of the most important sources of income, particularly in rural India. Small and marginal farmers, on the other hand, are not economically viable, and in the current technological and socioeconomic environment, they are unable to generate adequate income for their families in order to maintain a reasonable standard of living. To put it another way, a small plot of land used for some types of traditional farming cannot produce enough income to support a family's needs for food and other household expenses while also allowing them to live sustainably. Small farmers who solely depend on agriculture for a living must work incredibly hard to achieve the minimum subsistence level of income. Some evidence suggests that poor small farmers typically incur a net loss after the farming process. In this context, diversifying their cultivation practises may be a viable means of ensuring long-term livelihood opportunities by shifting from traditionally grown less profitable crops to more profitable crops. Agricultural diversification toward high-value or commercial crops such as vegetables, potatoes, sugarcane, horticultural crops, and fibre-crop cultivation may result in high income for farmers. Diversification is intended to provide a greater choice in the production of a variety of crops in a given area, as well as to expand production-related activities on various crops and reduce risk.

Extreme temperature, soil salinity, soil acidity, waterlogging disease, insect, and other biotic and abiotic stresses have become acute and are expected to have a significant impact on agricultural production in the future. At the same time, crop diversification may be an effective adaptation option in these situations because it protects natural biodiversity, strengthens the agro-ability ecosystems to respond to these stresses, reduces the risk of total crop failure, reduces the incidence of insect pests, diseases, and weed problems, and secures food supply opportunities while also providing producers with alternative means of generating income.

It improves food security by allowing farmers to grow surplus products for market sale, resulting in increased income to meet other needs related to household well-being. Farmers in affected areas must learn crop-production techniques, integrated farming systems (including crop rotation and intercropping), and climate-resilient production techniques. It can be implemented in a variety of ways and at various scales, allowing farmers to select a strategy that increases resilience while also providing economic benefits.

Climate change has resulted in an increase in unusual weather events such as severe drought and flooding, storms, cyclones, and heatwaves, all of which have had a significant negative impact on agricultural production. Increased agricultural crop diversification could be a rational and cost-effective solution. Diversification is a shift in product (or enterprise) selection and input use decisions based on market forces, farm conditions, and profit maximisation principles.

When compared to mono-cropping, diversification of maize and potato-based cropping through legumes, strip cropping, and agronomic practises reduces disease and pest infestation by 33.7 to 62.1% and pesticide use by 53.9 to 71.8%. Similarly, Pan *et al.*, 2020 reported that finger millet+black gramme and finger millet+horse gramme were the best cropping systems in eastern India for naturally controlling insect and weed pest diversity without compromising yield interest over finger millet mono-cropping.

Diversified cropping systems have thus not only reduced climatic and market risks, but have also resulted in a diverse and nutritious food supply at the household level. Governments must

therefore make efforts to fully explore the potential and prospects of crop diversification in order to forge a congruence of increased productivity, profitability, and sustainability.

What is the need for crop diversification?

- Adversities and climatic vagaries.
- Problems in maintaining input cost.
- Following same pattern extract specific nutrients from the soil.

Technologies help in providing opportunity for crop diversification

- Soil and water sensors.
- Weather tracking.
- Satellite imaging.
- Vertical farming.
- Mini-chromosomal technology.

Government policies and strategies for crop diversification

- Launching a technology mission for the integrated development of horticulture in the north-eastern region.
- Implementing national agriculture insurance scheme.
- Operationalizing technology mission on cotton.
- Creation of watershed development fund.
- Strengthening agricultural marketing.
- Seed crop insurance.

SPLIT GILLS MUSHROOM

FOR IMPROVEMENT OF HUMAN HEALTH

About Author

Pradeep Kumar Verma
Dr. Gopal Singh
Department of Plant Pathology

Vishal Srivastava
Department of Floriculture and Landscape Architecture

SVPUA&T, Meerut (U.P.)

Mushrooms are spore-bearing fruiting structures of basidiomycete fungi that grow above ground on soil. *Schizophyllum commune* is found in every continent except Antarctica. It is extensively spread throughout several Asian nations, such as North-East India and South-East Asia's Thailand, Laos, and Myanmar. It develops on broadleaf trees that have died, fallen, or have standing wood. It has thick white hairs, no stalks, and pale yellow to brown gills as characteristic. *Schizophyllum* is derived from "Schiza" meaning split; "commune" indicates common or shared ownership or omnipresent. The scientific name was assigned in **1815** by Swedish mycologist Elias Magnus Fries (1794–1878**),** also known as the Linnaeus of Mycology. Split Gill fungus caps are usually white and hairy, with a purple tint on rare occasions. Split Gill fruiting bodies grow in clusters, with each cap measuring up to 3cm in diameter and 1cm in thickness. The caps of neighboring fruiting-bodies frequently fuse together. They are pinkish-grey in colour, and depending on where they originate, they can radiate both centrally and laterally. They appear split lengthwise and frequently curl or fold over to shield the fungi's hymenium when the weather is dry. It was commonly consumed across the tropics, particularly in Mexico. It is known as kanglayen in Manipur, Northeast India, and is one of the favourite ingredients for Manipuri-style pancakes called paaknam. It is known as pasi in Mizoram (pa means mushroom, si means little) and is one of the most highly rated edible mushrooms among the Mizo people.

Nutritonal Value of Split Gills Mushroom

100 gram of dry split gills mushroom provide	
Nutrients	**100 gram**
Protein	15.9 g
Fat	2.0 g
Carbohydrates, Fiber	68.9 g
Phosphorous	408 g
Magenisium	277g
Calcium	188 g
Iron	12.3 g

Production technology

Split gill mushroom may be grown on different agro-waste material such as wheat straw, paddy straw sawdust etc. The substrate should be dry, healthy and un-decompose. Next process will be used soak the straw in clean cool water for 14-16 hour. Then spread straw on a sterilized raised platform to remove excess water to get 60-65 per cent moisture. Mix 0.5% $CaCO_3$ for adjustment of pH then fill the substrate in polypropylene bag @1-1.5kg/bag (wet straw) and Insert a PVC ring. Plugging of mouth of poly bags should be tight with using nonabsorbent cotton. Cover the cotton plug with a piece of silver paper or waste paper and tie tightly around the neck with a rubber band or jute thread. Sterilize the substrate using autoclave at temperature 121^0C for 1.5 hours. Then spawning should be done @ 2% wet weight basis under aseptic condition. Then placed all inoculated bags in spawn running room in the dark condition for 18-21 days. After completing mycelial run in bag, transfer the bags in cropping room (temperature 28 ± 2^0C and 80- 90% RH) then cut the top portion of the bags with help of sharp blade and spray cool water 2-3 times in one day for fruiting body development. After 2-3 days small primordia will develop. Full grown fruit bodies take 3-4 days then harvest.

1. Wheat straw soaked in water

2. Fill the substrate in bag

3. Fruiting body of Split gills

Biological efficiency remains between 7.5-12.5%.

Procedure

1. Wheat straw soaked in water.
2. Fill the substrate in bag.
3. Fruiting body of Split gills.

Medicinal Properties of Split Gills Mushroom

Split-gills have immunostimulatory, antimicrobial, antitumor, antineoplastic, and chemoprotective effects that are exceptionally strong even for a medicinal mushroom.

Antimicrobial

Schizophyllan ispolysaccharide effective against *Ehrich carcinoma*, sarcoma 180, and Lewis lung carcinoma. Extracts from *Schizophyllum commune* have been shown to be effective in treating bacterial and fungal illnesses, making them promising antibacterial agents.It inhibits the growth of *Candida albicans* and bacteria *Escherichia colli*, *Staphylococus aureus*, *Pseudomonas aerigunosa*, and *Klebsiellapneumoniae*.

Antitumor, and anticancer activities

Schizophyllan is a polysaccharide isolated from the fermentation broth of the microorganism *Schizophyllum commune* 80MI 509-01. Material of molecular weight 4.5×10^5 is used in the clinic for several forms of tumor, particularly cervical cancer.■

AN INSIGHT INTO SOLAR FARMING IN INDIA

About Author

V.V.S.S. Anusha
Research Scholar
Anand Agricultural University,
Anand, Gujarat

The term 'farming' is no longer exclusively conveying crops and livestock cultivation. A long stretch of paddy fields on either side of the road, a typical representation of a village, is on the verge of getting replaced by solar panels. Access to electricity across the globe, especially for developing and underdeveloped countries, was always challenging. With depleting, high-cost non-renewable sources of energy and increased power usage pushed us to strengthen our renewable sources. Generating power/ electricity using abundantly available sun (solar) light emerged as the most feasible and extensively practiced, leading to the establishment of solar farms.

About solar farming

When a piece of land is covered with a group of solar panels that generate electricity by utilizing the sunlight referred to as solar farming. The amount of power yielded will be based on the plant's size, the panels' capacity, and sunlight hours. The electricity could be used for household purposes, and the excess could be transferred to the utility power grid. This is called an on-grid system, where the units sent to the power grid are monitored, and an individual is paid for it. On days of undersupply of solar energy, the farm could draw power from the grid, causing no disturbances to the regular power supply. Solar farming in an isolated region where the shortage of power supply forces them to use all the power rendered can set up an off-grid system. Here, the power generated by the unit is wholly utilized for itself. Basically, solar farming as a concept enforces decentralization of power generation, which is a centralized activity by which accessibility increases that too at a lower cost.

Solar plans of India

The prestigious Paris Agreement signed at the Conference of Parties

(COP) 21, 2015 is where India committed to attain the long-term goal of 40% of its electricity from non-fossil fuels by 2030 and to yielding 175 GW of renewable energy (100 GW from solar) by 2022. The government drafted a series of activities in response to it, and greater efforts were poured into strengthening solar power.

1. **International Solar Alliance (ISA):**

Headquartered in Gurugram, Haryana, established in 2015, ISA is an intergovernmental organization that brings the world together to focus on the huge potential of solar energy.

2. **Prime Minister's Kisan Urja Suraksha Evam Utthan Mahabhiyan scheme (PM-KUSUM):**

Targeting the farmers and creating solar power in rural areas; this scheme launched in 2019 was operated under three components to generate 30 GW by 2022. It includes support for grid-connected solar pumps and power plants (on-grid) and stand-alone irrigation pumps (off-grid). Utilizing this scheme in the Kotputli tehsil of the Jaipur (Rajasthan) district, the first farm-based solar power plant has been built, producing 17 lakh units of energy annually.

3. When the targets are enormous, the availability of sufficient input becomes necessary, for which **production-linked incentives** are offered to encourage the manufacturing of local (Indian) photovoltaic cells.

Advance achievements of COP 21 targets, India's Prime Minister Narendra Modi notified at the meeting COP 26, Glasgow, countries' plans to attain 500 GW of electricity from non-fossil fuels. Globally, India stands in the fourth position concerning solar power generation. Focusing on solar farms becomes crucial to extract 50% of energy requirement from green sources to reach net zero by 2070.

Bhadla solar park of Rajasthan, one of the 42 solar parks in India, is the world's biggest solar power generator. Hereafter, establishing solar parks that practice solar farming will become a common phenomenon.

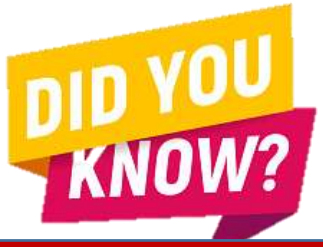
Agriculture v/s Solar farming - Need not be a conflict

The need for electricity powered by government schemes reaping the commercial benefits of solar farming will be alluring for any farmer tackling the uncertainties of agriculture. While the number of mouths to be fed reaches newer heights losing large pieces of productive lands would be a huge price. Any new problem stimulates excessive research, and studies suggest coexistence. The space between the solar panels can be used by shade tolerant (leguminous crops) and shorter-height crops. In hindsight, having the green cover in the solar farms would reduce the severe maintenance issue - dust accumulation. If not for agriculture, the grass/weeds growing between the panel areas would turn into feed for grazing livestock. Though raising the panels above the ground increases the cost as now they have to counteract wind effects but a worthwhile investment.

The agro-photovoltaic project laid out in Jammu and Kashmir is the best example. An area of 250 acres proposed for a solar plant generating 100 Megawatts of electricity that powers the valley is set to create 55 lakhs of annual revenue facilitating saffron cultivation.

Conclusion

Intensification of climate change with human-induced activities is forcing some global actions. Relying on renewable sources of energy should be the way ahead for sustainability. Of all, solar energy is readily available, accessible, and restored across areas. In this regard, solar farming emerged as a concept to fulfill our energy requirements in a greener way. As a country closer to the equator, India has access to abundant sunlight, becoming a pioneer in tapping the utmost potential. Incentivizing the production of solar panels and subsidizing the establishment of solar farms may sound promising, but it would not be enough to achieve the more important goals. Awareness about the need for solar panels, costs saved, profits obtained, and accessibility to the equipment will bring the concept of solar farming in India into reality.■



INTERNATIONAL YEAR OF MILLETS 2023

Millets can be introduced to children right from the age of 9 months.

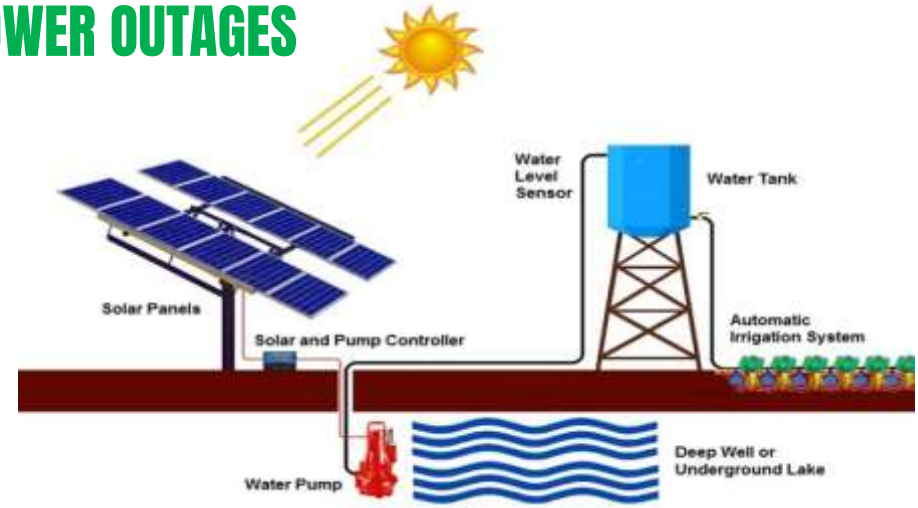
A SOLAR WATER PUMPING SYSTEM IN AGRICULTURE

TO BLOCK ELECTRIC POWER OUTAGES

About Author

S. Rahaman*
Ph. D., Scholar

B. Hari Babu
Associate Professor
Deptt. of Farm Machinery and Power Engineering
ANGRAU, Guntur (A.P.)



Requirement of solar pump sets and Its importance

A large percentage of our country's population depends on agriculture for their livelihood. Agriculture is practiced only in some areas with water available through canals. In most parts of the country, farmers rely on wells and pump sets for irrigation. Pump sets require an electric or oil engine to be used. Energy resources are gradually declining along with population growth. Energy consumption in many sectors will increase significantly due to the needs of a growing population. Coal reserves, which are conventional energy sources, are projected to deplete crude oil reserves by 30 to 35 years and natural gas reserves by 35 years. But the power generation is not increasing adequately. Due to this the difference between supply and demand of electricity during high demand is up to 30 percent.

In most areas the agricultural sector is highly dependent on electricity. Most of the times farmers are unable to provide water to their crops at the right time due to power cuts even though there is enough water available for the crop. Under such circumstances, the use of non-conventional energy sources such as solar powered pumps will enable farmers to overcome the problem of power shortage and provide timely water to their crops. The solar energy is available continuous from the sun. Solar energy is available for almost 300 days a year in almost all parts of our country by sun. A 4 to 7 units of solar energy per day per square meter of land is available. The use of solar powered pump sets can overcome the power shortage and provide water to the crop in a timely manner. The use of solar powered pump sets can be very useful for summer power shortages.

The farmer is struggling to irrigate his field in the face of declining groundwater and drought conditions in the Andhra Pradesh and Telangana states, which have established a stable foothold in India. There is water available in the borewells or open wells, due to power shortages the farmer is in such a dire situation that he cannot supply water to his farm. As a result, we often see crops drying up. Solar pump sets are very flexible to deal with such situations. The most important of the solar pump sets uses solar panel. They absorb sunlight as a natural source and convert it into electrical energy. Farmers need to allocate some space on his farm to utilize this technology.

How to install solar pump sets

The farmer should select the motor according to his bore size. Next the capacity of the solar panels will have to be calculated and fitted depending on the horsepower of the motor so selected. Typically, a single panel has a capacity of about 300 watts. The electrons in the solar panel travel directly. Hence electricity is generated directly from it. There is a risk of burning the motor if the current generated is connected directly to the motor. A control box should be fitted to prevent this danger. The current thus generated passes through the control box and is converted into 3 phase current and reaches the motor. This control box also acts as a starter and transformer.

Solar pump set capacity and its lifespan

The efficiency of solar panels depends on the availability of sunlight. Their lifespan is approximately 25 years. Especially the farmers in the Andhra Pradesh and Telangana states are small and lean farmers, the cost burden would be reduced if the farmers formed a community and bought these solar pump sets. These can be used not only for agricultural crops but also for drip irrigation for horticultural crops. To disassemble these solar pump sets the farmer must periodically clean the dust and dirt accumulated on the solar panels with a cloth to increase the dose of power. Central and state governments offer subsidize to reduce the cost burden on constantly struggling farmers. Since the electricity generated by these solar pump sets is environmentally friendly, farmers should promote this technology which is not harmful to the environment,

achieve high yields and do their part for the development of the country.

The main components of solar powered pump sets.

1. Solar panels
2. Battery
3. DC / AC inverter
4. Pump

Tiles absorb sunlight falling on solar panels. Solar cells mounted on solar panels convert the absorbed sunlight into electrical energy. This is called the photo-voltaic approach. The electrical energy thus generated is called DC, the DC power can be stored in battery and used when it needed. The higher the sunlight, the higher the electrical energy generated.

Advantages of solar water pumping systems:

1. **Low maintenance cost:** Unlike traditional motor pumps that require a lot of servicing and regular maintenance, solar pumping system requires less maintenance. This saves the cost as well as the labour involved.
2. **No fuel costs or spills:** Powered by solar panels, the solar pumping system does not require any additional fuel or electricity or any other medium to function. The energy comes from the sun and is completely free. Therefore, leading to zero-fuel costs.
3. **Eco-Friendly:** The system makes use of renewable energy and is sustainable. They do not produce harmful pollutants that could harm the air or soil.
4. **Easy to install:** the technology is user-friendly and does not require any special expertise. It can be easily installed and does not require much maintenance.
5. **Simple and reliable:** Being a user-friendly, easy-to-install, low-maintenance technology makes it a simple and reliable solution for your pumping requirements.

Disadvantages of solar water pumping systems:

1. **Potentially high initial costs:** The biggest disadvantage is that solar pumping systems are costlier than any other pumping system. For a one-time-investment, it could be heavy on one's pocket but if we consider the overall cost including fuel cost and maintenance charges, the solar pumping systems turn out to be much cheaper.
2. **Lower output in cloudy weather:** No matter how efficient the solar pumping system might be, it requires adequate sunlight to function properly. This can be its biggest disadvantage as on days of cloudy weather or during nights when the sun is not there, the solar pumping system will not be that effective and give low output. For good output, it must have good sun exposure.■

USE OF NANOTECHNOLOGY IN AGRICULTURE

About Author ...

Varuni Sharma
Graphic Era Hill University

Agriculture has always been the backbone of undergrowing nations. It not only satisfies people's stomachs but also gives a push to the economy. With the worry of giving food to the ever-growing population, there has to be a new technology providing more harvest in less time without polluting the environment for sustainable crop production. A more innovative way for sustainable agriculture comes out to be nanotechnology.

Nanotechnology can be made use of in the value chain of a complete farming-producing system. It is coming to be important as the sixth of government change technology in the current time. nanotechnology is a quick-moving growing field of science that is being made use of over a wide range of scientific training including farming.

The use of nanomaterials boosts the soil ph. and improves the soil structure. Nanomaterials also decrease the movability, availability, and toxicity of weighty metals as well as decreasing soil erosion. They also enhance the quality of soil by boosting water-holding capacity and nutrient availability.

Seed is nature's Nano-gift to man. The use of bio-nano-sensors particular to infecting pollen can help alert the possible infection and thus decreases the infection.

Carbon nanotubes (CNTs) serve the purpose of new pores for water percolation of the seed coat and act as a path for water from the substrate into the seeds.

Nanotechnology offers the possibility of exploring nano-scaled fertilizer-carrying structures and the controlled release of fertilizer, creating so-called smart fertilizers, increasing nutrient efficiency, and reducing the environmental pollution.

Nanotechnology is also used in agriculture to prevent waste. Scientists and companies are working on a nano-structured enzyme that will allow simple and cost-effective conversion of cellulose from waste plants to ethanol.

Nanotechnology will play an important role in the progression of the agriculture sector, as it is capable of being used in agricultural products that protect plants and monitor plants, and detect diseases. scientists have been working to explore new applications of nanotechnology in agriculture, if this technology is applied efficiently and ethically; the environment and the agriculture sector will clearly see remarkable changes for the better in the coming years.■

ARTIFICIAL INTELLIGENCE AND ITS ROLE IN AGRICULTURE

About Author

K. Laxmi Prasanna*
M. Sc Scholar
Ajay Pratap Singh
Ph. D Scholar
ANDUAT, Kumarganj, Ayodhya (U.P.)

The global population is expected to exceed nine billion by 2050, necessitating a 70% increase in agricultural production to meet demand. Only about 10% of this increased output could be attributed to the availability of unused land, with the remaining 90% being met by increasing current output. In this context, one of the most important requirements is the use of cutting-edge technological solutions. Scarcity and rising labor costs, rising cultivation and crop failure costs associated with unpredictable yield due to diseases, failure in rainfall, climatic variations, and loss of soil fertility, fluctuating market prices in agricultural commodities, and so on, have all had a significant negative impact on the socioeconomic status of this agriculture population. On the other hand, the increase in population has boosted the economy for grains, leading to an increase in the price of agricultural commodities. Artificial intelligence can create efficient farming methods that minimize farmer losses and give them high yields. One can collect a lot of data from public and governmental websites using artificial intelligence platforms, or one can monitor various data in real-time.

Importance of AI in agriculture

Today, farming can use artificial intelligence (AI). AI-powered solutions will not only help farmers produce more with fewer resources, but they will also increase crop quality and hasten the time it takes for crops to reach market. Artificial Intelligence and Big Data are two modern technological advancements that are increasingly driving the provision of digital IT solutions across almost all industries and business sectors. The IoT (Internet-based Technology), image-based insight generation, and an optimal mix for agronomic production forms the bulk of the artificial intelligence paradigm.

Currently used AI technologies in agriculture

- **Blue River technology:** This company was established in 2011 and is based on Artificial Intelligence. This California-based startup combines artificial intelligence, computer vision, and robotics to create next-generation agricultural equipment that reduces chemical use and saves money. In this case, computer vision identifies each plant and determines how to treat each plant, while robotics allows smart machines to act. It employs sensors to detect weeds, the type of weeds, and the appropriate herbicides to apply within the appropriate buffer zone around the plant. The appropriate herbicides are then sprayed precisely according to the encroachment area. Blue River Technology has developed a robot called **See & Spray** which reportedly leverages computer vision to monitor and precisely spray herbicide on weeds.
- **Farm Bot:** This Company was founded in 2011 and has taken precision farming to a new level by allowing people who care about the environment to grow crops in their own backyards using precision farming technology. Everything from seed planting to weed detection and soil testing to plant watering is handled by this physical bot using an open-source software system.
- **Harvest CROO Robotics–Crop Harvesting:** Harvest CROO Robotics has generated a robot to assist strawberry farmers with picking and packing their crops. The robot picks up strawberries, allowing farmers to save money on harvest labor. Strawberries must be picked within a specific time frame, so qualified pickers are required. Harvests

CROO Robotics believes that their product will save money, increase yields, reduce energy consumption, and improve quality.

- **Plant diseases diagnosis app-Plantix:** PEAT, a Berlin-based agricultural tech startup, created the Plantix app, which detects potential soil defects and nutrient deficiencies. The app detects plant diseases using images. A smartphone collects an image, which is compared to a server image, and then a diagnosis of the plant's health is provided. In this way, the application solves plant diseases by utilizing AI and machine learning.

- **Prospera:** This Israeli start-up was set up in 2014. It has created a cloud-based solution that aggregates all existing data from farmers, such as soil/water sensors and aerial images. Then it is combined with an in-field device that makes sense of everything. A variety of sensors and technologies, such as computer vision, power the Prospera device, which can be used in greenhouses or in the field. The sensor inputs are used to find a correlation between different data labels and to make predictions.

- **Drones, satellites, and planes:** Drones and planes aid in the collection of aerial data, which is just as useful in analyzing farm conditions as ground data. The technology employs computer vision algorithms as well as image annotation to assist farmers in identifying potential problems and solutions. Drones, planes, and satellites can perform data analysis and collection tasks much faster than humans.

- **Image-based insights for crops & soil health:** Drone technology can provide high-quality imaging while also improving crop monitoring procedures. It analyzes, scans, and collects field data in real time and aids in crop progress stage identification. For example, it informs about their health, any disease or pest attack, and when they will be ready. Furthermore, this technology entails overall field management and indicates when crops require water, fertilizer, pesticides, or soil.

Challenges with artificial intelligence in agriculture

Despite the fact that Artificial Intelligence has numerous applications in agriculture, most farmers around the world are unfamiliar with high-tech machine learning solutions. Farming is extremely vulnerable to external factors such as weather, soil conditions, and pest presence. AI systems require a large amount of data to train machines and make accurate predictions. When it comes to vast agricultural land, temporal data is more difficult to obtain than spatial data.

Conclusion

AI technologies assist farmers in analyzing land/soil/crop health, among other things, saving time and allowing farmers to grow the best crop for each season. AI-based predictions allow for the recommendation of appropriate pesticides/crops/locations at the right time, prior to disease outbreaks on a large scale. The agriculture industry has a huge opportunity to leverage emerging technology to provide farmers with answers to all of their questions and relevant advice and recommendations for their specific farm-related problems.

ATMOSPHERIC CORRECTION OF HYPERSPECTRAL IMAGES

About Author

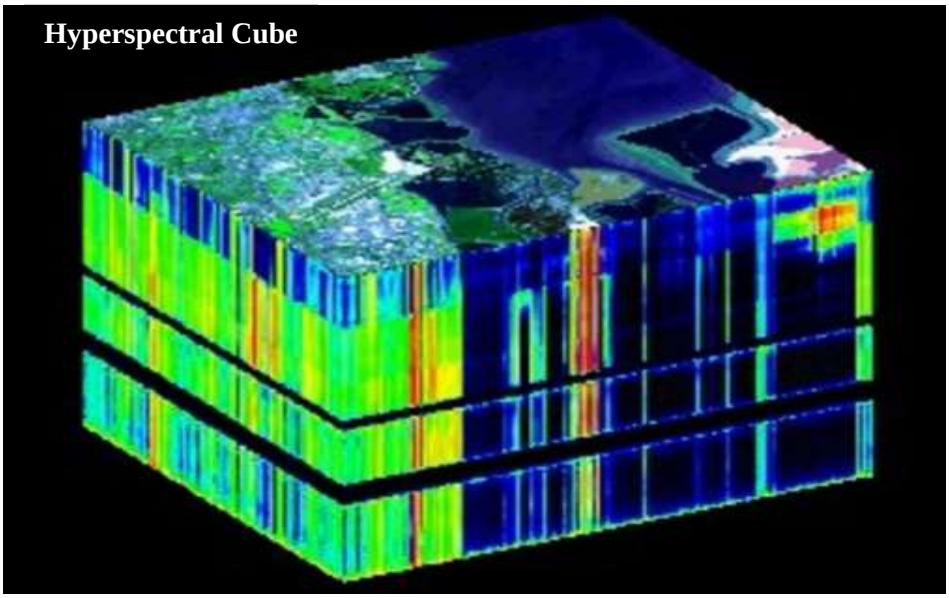
S. Janarth
Ph.D. Scholar
Deptt. of Remote Sensing and GIS, TNAU, Coimbatore

Hyperspectral Image

A novel method of analysis built on spectroscopy is called hyperspectral imaging. It gathers hundreds of photos for the same spatial area at various wavelengths. Hyperspectral imaging captures the continuous spectrum of the light for each pixel of the image with precise wavelength resolution, not just in the visible but also in the near-infrared, in contrast to the human eye's three colour receptors (blue, green, and red). The gathered information is organised into a "hyperspectral cube," which has three dimensions: two of which indicate the scene's spatial extent and the third its spectral content.

Processing of Hyperspectral Imagery

Hyperspectral sensors can now collect imagery with hundreds of bands across the spectrum thanks to recent developments in sensor technology. The expansion of bands, however, is both a blessing and a punishment. More materials can be distinguished by their unique spectral responses thanks to the large number of bands. However, the characteristic that makes analysis procedures hard is the high number of bands. The USGS, NASA's Jet Propulsion Laboratory, ENVI, and other organisations frequently employ the approaches that are detailed in the



following sections. However, there are more techniques and algorithms for gathering data from hyperspectral sensors. Understanding the differences involved in working in n-dimensional space is one challenge when working with hyperspectral data. One must be cautious when drawing inferences in higher level regions utilising two- or three-dimensional conceptual truths.

Necessary Atmospheric Correction:

Sometimes it is essential that the remotely sensed data be atmospherically corrected. For example, it is usually necessary to atmospherically correct the remote sensor data if biophysical parameters are going to be extracted from water bodies (e.g., chlorophyll a, suspended sediment, temperature) or vegetation (e.g., biomass, leaf-area-index, chlorophyll, percent canopy closure). If the data are not corrected, the subtle differences in reflectance (or emittance) among the important constituents may be lost. Furthermore, if the biophysical measurements extracted from one image (e.g., biomass) are to be compared with the same biophysical information extracted from other images obtained on different dates, then it is usually essential that the remote sensor data be atmospherically corrected. For example, consider the case of the normalized difference vegetation index (NDVI) derived from Landsat Thematic Mapper (TM) band 3 (red) and band 4 (near-infrared) data: which is used routinely to measure vegetation biomass and functional health in many decision-support systems such as the Africa Famine Early Warning System and Livestock Early Warning System.

Types of Atmospheric Correction

ACORN Atmospheric CORrection CORrection **N**ow is based on MODTRAN 4 radiative transfer code. It performs atmospheric correction of both multispectral and hyperspectral imagery in the region from 250 ± 2,500 nm. It is designed to work with all airborne and spaceborne calibrated remote sensing systems such as Hyperion, ASTER, Landsat ETM +, AVIRIS, SPOT, GeoEye-1, etc. It defines the relationship from contributions of the exo-atmospheric solar source, a homogenous plane parallel atmosphere, and the surface with respect to the radiance measured by an Earth-looking remote sensor. It is suggested that all model-based atmospheric correction algorithms such as ACORN and FLAASH basically use the radiative transfer model.

FLAASH ENVI's Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes Hypercubes was developed by the Air Force Phillips Laboratory, Hanscom AFB and Spectral Sciences, Inc. FLAASH is an atmospheric correction program that corrects remote sensor data in the region from 400 ± 3,000 nm. FLAASH can be used to atmospherically correct data from hyperspectral sensors such as HyMAP, AVIRIS, HYDICE, HYPERION, Probe-1, CASI, and AISA and multispectral sensors such as ASTER, IRS, Landsat, Rapid Eye, and SPOT. FLAASH uses MODTRAN simulations of spectral radiance computed for various atmospheric, water vapor, and viewing conditions (solar angles) over a range of surface reflectances to establish lookup tables for the atmospheric parameters of column water vapor, aerosol type, and visibility for subsequent use. The 1.13 µ m water band is used to estimate water vapor, and a ratio of in-band and out-of-band radiance values allows estimation of absorption band depths for a range of water vapor column densities.

QUAC: ENV I's Quick Atmospheric Correction (QUAC) is a visible-near infrared through shortwave infrared (V NIR-SW IR) atmospheric correction method that can be used for both multispectral and hyperspectral imagery. Unlike ACORN and FLAASH, it determines atmospheric compensation parameters from the information contained within the image such as pixel endmember spectra (i.e., pure, unmixed pixels in the scene), without ancillary information. QUAC performs a more approximate atmospheric correction than FLAASH or other physics-based first-principles methods, generally producing reflectance spectra within approximately ± 15% of the physics-based approaches. QUAC is based on the empirical finding that the average reflectance of a collection of diverse material spectra, such as the endmember spectra in a scene, is essentially scene-independent.

ATCOR: The ATmospheric CORrection The ATmospheric CORrection program was originally developed at DL R, the German Aerospace Centre. ATCOR consists of ATCO R 2 (used for flat terrain) and ATCOR 3 (used for rugged terrain, i.e., the 3 stands for 3 dimensions).■

e-NAM POP
(PLATFORM OF PLATFORMS)

About Author

Manju Singh*
Ph.D Research Scholar
Deptt. of Agronomy

Shwetank Shukla
Ph.D Research Scholar
Deptt. of Soil Sci. & Agril. Chem.

Praveen Singh
Ph.D Research Scholar
Deptt. of Meteorology
ANDUAT, Ayodhya (U.P.)

e-NAM (National Agriculture Market & 'e' is to be constructed as electronic or digital) Portal is a pan-India electronic trading portal. It is the network of the existing APMC (Agricultural Produce & Livestock Market Committee) mandis for creating a single national market platform including farmers, traders and buyers for the agricultural products. Prime Minister of India, Narendra Modi, launched this electronic market pilot across India on 14 April 2016. This portal is handled by the SFAC (Small Farmers Agribusiness Consortium) with the technology provider, NFCL's iKisan division under the Ministry of Agriculture and Farmer's Welfare, GOI. It has wider vision for promoting uniformity in Agriculture marketing and real time price discovery between buyers and sellers based on actual demand and supply with the mission of Integration of APMCs across the country by a common online market platform to facilitate pan-India trade in agriculture produces, providing better price discovery by transparent auction along with timely online payment.

Current status

The e-NAM is linked with 1000 markets (APMCs) in 18 states and 2 union territory, with over 50 lakh farmer membership in 18 states. The market is helping traders and exported in producing quality products in bulk, at one place and ensure transparent financial transactions.

Recently, 10 new commodities added on e-NAM and the total is 203 Commodities are available at e-NAM portal namely;

Fruits: Baji banana, Mysore banana, Lady finger banana, Red banana.

Food Grains: Foxtail millet

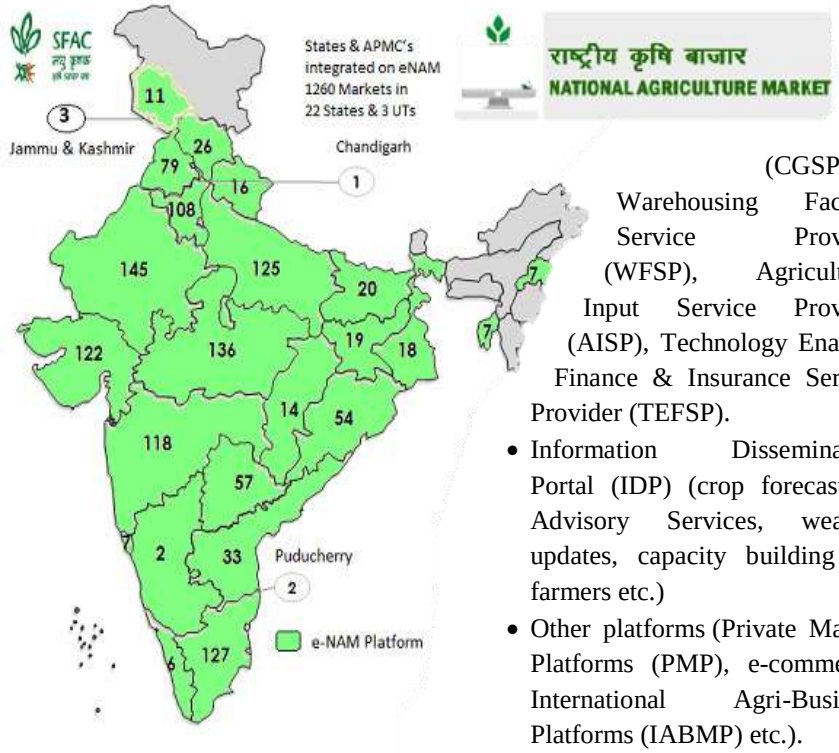
Miscellaneous: Raw arrowroot powder, Banana stem, Raw honey, Silk cocoon, Green, Heena leaf.

e-NAM Platform of Platforms (POP):

Platform of Platforms (POP) Launched under the e-NAM (National Agriculture Market) by Honourable Union Agriculture Minister on 14th July 2022 at National Conference on Agriculture & Horticulture Ministers in Bangalore. Farmers can take advantages of the facility of partial payment in cash (as per the limits set by the respective states) and remaining in their bank account for e-NAM trade. This is towards strengthening the vision of Hon'ble Prime Minister towards "Ease of Doing Business".

The platform of Services Providers is integrated by e-NAM "Platform of Platforms" which includes:

- The Composite Service Providers (CSP) (Quality analysis, trading, payment systems and logistics are some of the services provided by the service provider).
- Logistics Service Provider



(LSP), Quality Assurance Service Provider (QASP), Cleaning, Grading, Sorting & Packaging Service Provider (CGSPSP), Warehousing Facility Service Provider (WFSP), Agricultural Input Service Provider (AISP), Technology Enabled Finance & Insurance Service Provider (TEFSP).

- Information Dissemination Portal (IDP) (crop forecasting, Advisory Services, weather updates, capacity building for farmers etc.)
- Other platforms (Private Market Platforms (PMP), e-commerce, International Agri-Business Platforms (IABMP) etc.).

Benefits of PoP (Platform of Platforms)

- The PoP (Platform of Platforms) will assist farmers in exporting their produce outside of their states and improve the price search mechanism.
- Farmers and stakeholders will have access to a range of products and services through a single point of contact according to a statement from the ministry.
- POP facilitating various value chain services like trading, quality checks, warehousing, fintech, market information, transportation etc with 41 service providers from different platforms. it will bring transparency in business transactions with improving farmers' digital access to multiple markets, buyers and service providers.
- Farmers will be able to sell the produce outside of their state borders.
- The time and labour of the stakeholders can be saved by selecting a good quality Goods/Service Providers.

■■■

STUDENT READY
RURAL ENTREPRENEURSHIP AWARENESS DEVELOPMENT YOJANA

About Author

Roshan Kumar Yadav*
M.Sc. (Ag.)
Dr. B. S. Badhala
Asstt. Profesor
Deptt. of Extension Education,
SKNCOA, Jobner (Jaipur)

The Indian council of agriculture research is committed improve the employment of the agriculture of the agriculture graduates. Main aim to support this by development and implementation of programmes which would train the agriculture student for entrepreneurship through the icar partnership with the agriculture universities located all over country. In this direction the student READY (Rural entrepreneurship awareness development yojana) programme was launched from the academic session 2016 -17 as per the recommendation of fifth dean committee. The Student READY (Rural Entrepreneurship Awareness Development Yojana) programme aims to provide rural entrepreneurship awareness, practical experience in real-life situation in rural agriculture and creating awareness to undergraduate students about practical agriculture and allied sciences.

SKNCOA jobner Jaipur student READY student programmes

Well-structured one year programme which includes several components designed to provide the desired skills to our agriculture graduates. Though the student READY programme is still at its nascent stages it has been appreciated by all corners. The students were trained to acquire knowledge in various field of their interest.

The following components are proposed for carrying Student READY programme

- Experiential Learning on Business Model / Hands on Training.

- Experiential Learning on Skill Development.
- Rural Awareness Works Experience (RAWE).
- Internship/In-Plant Training /Industrial attachment.
- Students Projects.

Experiential learning on Business Model/Hands on Training

Hand–on training aims to make conditions as realistic as possible towards gaining knowledge and skill for doing the different productivity on farm operations. The student is provided opportunities to become skilled in the identified practices / methods. The students strengthen their existing skills and also learn new techniques. A number of experimental leavening units are also being used for hands on training.

Experiential learning on skill development

Experiential learning is an opportunity for the students to develop high quality professional competence, skill development and confidence to start their own enterprise. This is a step towards "Earn while learn". Experiential Learning aims towards Practical Work Experience in Real Life Situation among the undergraduate students and therefore it helps student become "Job Providers rather than Job Seekers".

Rural Awareness Works Experience (RAWE)

Rural Awareness Works Experience enable the students to gain rural experience, give them confidence and enhance on farm problem solving abilities in real life situations, especially in contact with farmers, growers, etc.

Internship / In-Plant Training / Industrial attachment

In-plant training of short duration in relevant industry is useful to gain the knowledge and experience of the work culture. In Plant training in reputed organization / MNC's/ other organised sectors provides an industrial exposure to the students for developing their career in the agri based industries.

Students projects

Student project is essential for students who are interested in higher education. Through this they will gain expertise for identification of research problem, planning and setting up experiments and writing of reports, etc.

DID YOU KNOW?

INTERNATIONAL YEAR OF MILLETS 2023

Millets need to be soaked before 5-7 hours before preparing.

WHAT ARE YOU DRINKING IN THE NAME OF COWS MILK... DID YOU KNOW THE DIFFERENCE...?

About Author

Zine. P.L.*
Ph.D. Scholar
Londhe. G.K.
Head
Deptt. of Animal Husbandry and Dairy Science,
College of Agriculture, Vasantrao Naik Marathwada Krushi Vidyapeeth
Parbhani

India is the world leader in milk production, accounting for 23 per cent of the global share. It also has the largest cattle inventory in the world. Milk and milk production has always been an integral part of the Indian economy and food. Cow and buffalo are the two main animals used for milk and milk-related products (such as ghee, curd, and paneer). The cows used in milk production belong to two categories - indigenous cattle breeds' native to the Indian subcontinent and hybrid cows native to other areas (mainly Europe). Hybrid cattle have more than one breed of ancestors. There are many differences between the two categories of cows. These dissimilarities extend not only to the animals but also to the milk and other products derived from them.

A2 Cow Breeds (Indigenous Breeds)- Gir, Rathi, Red Sindhi, Sahiwal and deoni.

How are Desi Cows and Hybrid Cows Different?

A2 Cow (Desi Cow)	A1 Cow (Hybrid Cow)
Milk from A2 cows contains only A2 milk beta-casein.	Milk from hybrid cows contains both A1 and A2 milk beta-caseins.
They have humps, longer necks with folds, and curved horns.	They have no humps, shorter necks with no folds, and short horns
Low yield of milk - in the range of 10-20 litres per day.	High yield of milk - easily up to 30-35 litres per day.
Gives immense health benefits - highly rich in vitamins, good cholesterol, and many other micronutrients.	Low on nutrition and therefore has fewer health benefits.
A2 cows are very sturdy and less prone to diseases.	Hybrid cows are more vulnerable to diseases since they are not native breeds.
High maintenance costs including fodder, low yield, and authentic processes.	Low maintenance costs due to less amount of feed and higher milk yield.

A1 Cow or Hybrid (Imported) Cow Breeds- Jersey, Holstein Friesian, Ayrshire.

Milk Beta-Casein

The main difference between the two categories of cows is the beta-casein protein found in the milk they produce. A2 cows have only A2 beta-casein, whereas hybrid cows have both A1 and A2 beta caseins. Milk with only A2 protein is much more beneficial. The indigenous breeds of India produce A2 milk protein only, and that is why they are also referred to as A2 cows.

Physical features

There are prominent differences in the physical features of the A2 cow and hybrid cow. Some of these are:

Hump

A2 cows like Gir have a hump, which absorbs energy from the sun. The specific vein which allows the cows to do that is also known as *Surya Ketu Nadi*. The milk from humped cows helps us to absorb Vitamin D and also boosts immunity. Hybrid cows do not have a hump and hence the benefits are not passed onto the milk they produce.

Neck

Desi breeds have a longer neck with skin folds Hybrid cows have a shorter neck with no folds.

Horn

Desi cows have curved horns with a thick base. Hybrid cows like Jersey have large heads and relatively short horns.

Milk yield

Indigenous cattle breeds have relatively lower yields when compared to hybrid cows. A jersey cow can easily produce up to 35 liters of milk daily, while A2 cows like gir can give only up to a maximum of 10 litres per day. This huge difference in yield also contributes to the high cost of maintaining desi A2 cows and the milk they produce.

Health benefits

Milk and milk products such as, curd, buttermilk, paneer and ghee that we get from A2 cows are much more beneficial to human health. A2 milk boosts immunity and contains many vitamins and other micronutrients that improve the functioning of our body parts like the eyes, bones, brain, and digestive system among others. Milk derived from A1 or hybrid cows is not as beneficial. It also lacks carotene (it converts to Vitamin A) that is present in A2 milk. A2 milk also has colostrum similar to a mother's milk. Colostrum contains many antibodies that are good for human health and immunity.

Susceptibility to diseases

Desi breeds of cows adapt to the hot and humid climatic conditions in India very well. They are sturdy and less prone to diseases and infections. Hybrid cows are not so well adjusted to the weather and are much more vulnerable to falling sick.

Maintenance cost

To get nutritious A2 milk, the feed and fodder given to the cows have to be rich in nutrients. The maintenance cost for A2 cows is relatively high. The hybrid cows consume less fodder while yielding almost double the amount of milk. Their maintenance cost is lesser.

Conclusion

The high milk yield of hybrid cows has made many producers adopt them as milch animals over indigenous desi cows. Lower maintenance cost also make financially more attractive. However, milk from hybrid cows has lesser nutrition. A2 cows or desi cows are not only well adjustable to their native environment, but they are also less prone to diseases. The A2 milk and its products are super beneficial for human health. They boost immunity and improve body functions.

■■■

DHAINCHA FIBRE

REINFORCING MATERIAL IN BIOCOMPOSITES

Shalini Rukhaya*
Research Scholar
Neelam M. Rose
Professor
Saroj Yadav
Assistant Professor
Neenu Poonia
Deptt. of Textile and Apparel Designing CCS HAU, Hisar (Haryana)

The concept of using naturally derived fibres from plants as reinforcement in a composite structure has been successfully utilized by multiple civilizations throughout world history and therefore is not new. A variety of materials can historically be pointed out as to which plant fibre to use as a means to enhance stiffness, strength, and impact resistance of a given material. However, over the past couple of decades a renewed interest and focus on the advanced utilization of different varieties of naturally occurring fibres as reinforcing agents in polymer matrices has been realized worldwide. Biocomposites from local and renewable resources which offer significant sustainability, industrial ecology, eco-efficiency, and green chemistry are guiding the development of the next generation of materials, products, and processes. Considerable growth has been seen in the use of biocomposites in the domestic sector, building materials, aerospace industry, circuit boards, and automotive applications stimulating an increase in demand.

Utilization of agro-waste

Many types of natural fibres have been investigated with polymer matrices to produce composite materials that are competitive with synthetic fibre composites which requires special attention. The agricultural wastes can be used to prepare fibre-reinforced polymer composites for commercial use and have marketing appeal. It is reported that about 600 MT of wastes have been generated in India from agricultural sources alone. The major quantity of wastes generated from agricultural sources are most importantly rich resources of lignocelluloic materials includes sugarcane bagasse, paddy and wheat straw and husk, bast fibres, coconut husk, cotton stalk, etc. The studies of agro-waste and natural fibres composites have attracted due consideration from academicians and industrialists for their excellent properties such as improve mechanical strength, water and oxygen barrier, dimensional stability, wear resistance etc. More so, the inherent quality outputs of waste material composites such as low cost, biodegradability, low specific gravity, availability, high strength offer

the use of agro waste composites in variety of practical applications.

Natural fibre based bio-composites

Composite material is a combination of two different materials with discrete properties and produced with the reinforcement of a matrix structure. Ecological problems in recent decades have urged the necessity to look for new alternatives which could replace the traditional composites with lower environment impact materials. This created a renewed interest in natural materials which could be used as reinforcements or fillers in the composites and are thus referred to as "natural fibre reinforced composites" or "biocomposites." Natural fibres are classified based on their origins that are derived from plants, animals, or minerals. Polymer matrices can be divided into two types; one is synthetic petrochemical based called synthetic matrix and the other is natural or bio-based called biodegradable matrix.

A biocomposite material is a material formed by a matrix with a reinforcment, usually natural fibres arising mostly from plants or cellulose. Environmental concern and cost of synthetic fibres have led the foundation of using natural fibre as reinforcement in polymeric composites. Advocates of biocomposites state that use of these materials improve health and safety in their production, are lighter in weight, have a visual appeal similar to that of wood, and are environmentally superior.

The application of biocomposites for replacing existing synthetic polymer or glass fibre reinforced materials is huge. Automotive and aircrafts industries have been actively developing different kinds of natural fibres and bioresins systems for their interior components. High specific properties with lower prices of biocomposites are making it attractive for various other applications also such as furniture, packing and construction. This is mainly due to their advantages compared to synthetic fibres, i.e. low cost, low weight, good relative mechanical properties, abundant and renewable resources. Therefore, unlike synthetic fibres, natural fibres can be incinerated at the end of useful life with enhanced energy recovery and no net addition to CO_2 emissions, which leads to positive carbon credits and lower global warming effect.

Dhaincha fibre as reinforcement material

Fibres are the reinforcing agents of the biocomposite materials and main part of the composite system that carries structural loads. Plant or lignocellulosic fibres are promising reinforcement agents which are getting more attention by the researchers and the industry due to the concerns of sustainability and renewability. Lignocellulosic fibres are formed basically from cellulose, hemicelluloses and lignin. Also, lignocellulosic fibres may contain other different substances depending on the plant, region, species, etc., such as waxes, pectin, starch, etc.

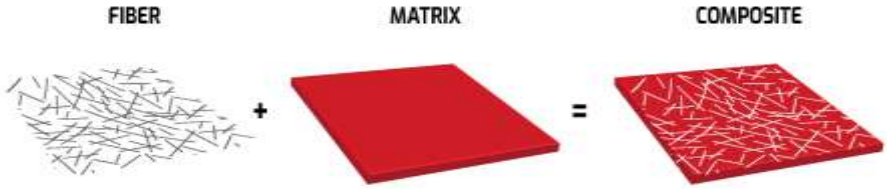
Dhaincha (*Sesbania aculeata*) is a leguminous plant (fabaceae) and cultivated in user or waste land for its reclamation or green manuring of the soil with source of organic matter and nitrogen fixer. *Dhaincha* is lingo-cellulosic material, which reduce soil erosion and increase soil fertility having multipurpose uses and fast growing characteristics. It is an annual shrub which can grow to seven metres in height but usually only reaches one to two metres. It sends out fibrous, pithy stems with long leaves and bears purple-spotted yellow flowers. It produces pods which contain light brown beans.

***Dhaincha* Plant**

Extracted Fibre

Biocomposites

This crop is adapted to wet areas and heavy soils, which does not require much preparation. This land can be utilized for production of eco-friendly, biodegradable and natural fibres of *dhaincha* instead of synthetic fibres to produce biocomposites which can be utilized in various sectors. The fibre is derived from its stem which are harsh, coarse and shiny in appearance but lacks elasticity. Fibre is also utilized for making fish net, and rope, sackcloth, sailcloth and cordages. Due to its characteristics, fibre is used only for coarse structures and could be exploited for several other applications also. As a reinforcement material in biocomposites it can be used in various industries like automotive, aircraft, sporting goods, packaging, marine, electronics etc. ■



NANOTECHNOLOGY IS A BOON
TO MAKE A SMART AGRICULTURE IN INDIA

About Author

Umesh Kumar*
Rishikesh Yadav
Sandeep Yadav
Deptt. of Soil Sci. & Agril. Chem.
ANDUAT, Kumarganj, Ayodhya

Agriculture is the backbone of most of developing countries in which a major part of income comes from the agriculture sector and more than half population mostly depend on it. First time nanotechnology term evolved by NorioTaniguchi in 1974. Nanotechnology is the branch of science which deals studies of understanding matter at nanometer 1 to 100 nm. Among the many scientific advancements nanotechnology is one of the potential technology in agriculture and allied sectors. Nanotechnology helps in agriculture and allied sectors to control a environmental pollution using through nanoparticles and nanocapsules and also decreases the rate of absorption of pesticides and chemical fertilizers.

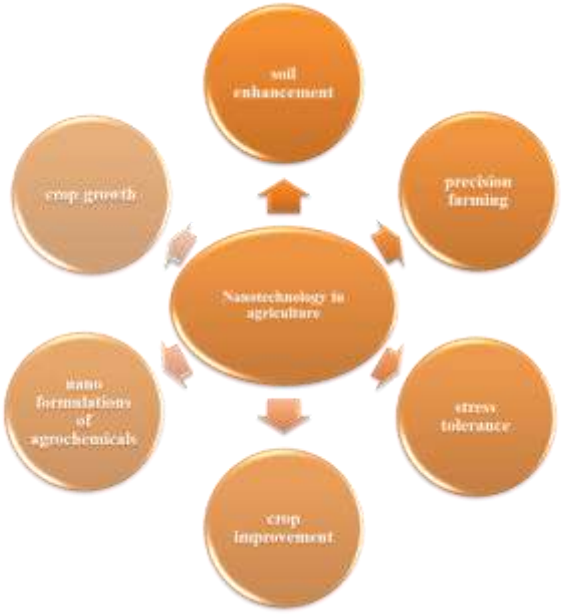
Objectives of smart agriculture:

- Optimizes the crop productivity.
- Maximizes the yield.
- Increases efficiency like as water use efficiency, fertilizer use efficiency.
- Reduces emissions from agro-chemical manufacturing company.
- Sharing knowledge in balanced and crop specific nutrition (Integrated Nutrient Management).
- Adopt new technology development.

Application of nanotechnology in agriculture and allied sectors:

The application of nanomaterials in agriculture, the main aims especially application of macro and micronutrient fertilizers and plant protection products that minimizes the nutrient losses in fertilizers and increases the yield through optimized nutrient management. Nanotechnology is a tools like nanoparticles, nanocapsules and even viral capsids, are examples of uses for the enhancement of nutrient absorption by plants, detection of disease and their treatment of its pathogen, the delivery of active ingredients to specific sites and water treatment process.

In food sectors organic, inorganic, and combined nanoparticles are used to prepare improved active and intelligent food packaging. Thus helps in prolanging the shelf life of food. Nanomaterials in food provide many benefits such as detection of microbial contamination and enhances bio availability of nutrients in food. Nanostructure and nanomaterials with unique physical, chemical and Mechanical properties for example, active carbon nanotubes, fullerense and nanofibers have been recently evolved and applied for sensitive biochemical sensors. These nanosensors have been also applicable for agriculture, especially for soil analysis, water management and delivery systems, pesticides and nutrient delivery systems, and easy biochemical sensing and control.



Conclusions

Nanotechnology plays important role in overal agriculture development like as crop improvement, plant protection, livestock production, food processing and packaging, environmental remediation and water purification etc. In the modern era nanotechnology are used intensively and are becoming a part of human life. Precision farming becomes highly advanced and accurate when we are choose for synergistic approach of using smart Nano sensors , wireless sensors, agrinfortronics, ambient intelligence etc. which allows improved productivity by using precise information. Thus benifitted for farmers with superior decision.■

HYDROPONICS

Aishwarya Pandey
Graphic Era University
Dehradun

Hydroponics is a type of horticulture and it is a set of Hydroculture (Water culture) which involves growing of different plants, crops and some medicinal plant without involvement of soil or without sowing in the soil. Hydroponics is also called soilless culture or aquaculture.

Hydroponics are used with water-based mineral and nutrients solution (aqueous solvents are used). Aquatic plants (which are easily used to live in aquatic environment or freshwater) may grow with their roots exposed to the nutritious liquid or roots may be mechanically supported by an inert medium such as gravel or other substrates. Through this inert medium roots cause changes in the rhizosphere pH can effected the rhizosphere biology and physiological balance of the nutrient solution and this is done by secondary metabolites. The nutrients used in hydroponic system may be obtained from many different type of organic and inorganic sources, which including also dunk manure, some chemical fertilizers or some artificial nutrient solution. Hydroponically plants are commonly grown in greenhouse or contained environment or in inert media and adapted to the controlled environment agriculture (CEA) process.

History

Hydroponics is discovered by William Frederick Gericke in 1937. He grew tomato vines about meters high in his backyard in a mineral nutrient solution in the university of California. The word hydroponics is derived from two greek words, the 1st word is hydro which meaning water and the 2nd word is ponos which meaning labor. Literally water-working is the meaning of the word hydroponics.

Some plant example

A wide variety of vegetables and floriculture crops can be grown satisfactorily with hydroponic system. Some example of plants are tomato, cucumber, strawberries, peppers, lettuces and spinach.

Advantages and Disadvantages

Hydroponic systems have a large number of advantages and disadvantages compared with the soil cultivation.

Advantages of hydroponics

- Decrease the water usage in agriculture lands.
- Hydroponics culture leads to highest biomass and production of protein than other growth substrates in the same environment conditions with same nutrients amounts.
- Hydroponics cannot be harsh to the environment.
- In future, with less amount of water we can grow many plants or produce.
- Hydroponics is not only used on earth, but has also proven itself in plant production experiments in the space.
- The plants also have less roots.
- Hydroponic plants have less nutrients competition than those plant which are grown in soil.
- Saving of laboring costs by automatic water watering and fertilizing.
- Hydroponic systems can be set up indoors places that would not normally be available for the plants growing, such as in populated areas.
- People with limited or no outdoor space such as urban residential people are used to grown plants.
- Fewer pest problems in the hydroponics system.

Disadvantages of hydroponics

- High installation costs or expensive to set up.
- The need to test the solution frequently.
- Proper knowledge and learning about the hydroponics system.
- One small errors can also affect the whole crop.
- Yields are about the same as for soil grown crops.
- Vulnerable to power outages (it depend on electricity power)
- It required constant monitoring and maintenance.
- Water borne diseases are affected higher.

How does a hydroponics system work?

Plant growth primarily depend upon the three main component: essential nutrients, water and light of sun. A hydroponics system eliminates the essential for soil by providing nutrient charged in a aqueous solution directly to the roots that keeps the plant fed and hydrated them, while supplemental lighting solutions mimic sunlight.

There are three main types of the hydroponics which is based on how physical support for plants is provided, (1) plants grow on substrate in media beds (2) in the nutrient film techniques roots of plant grow in the wide pipes with a trickle of water, (3) in the deep water culture or floating system, the plants float in a tank of water.

Conclusion

Post evaluation of the advantages and disadvantages regarding hydroponic system we came to know that It is good for growing different plants but not in majority of people could use it, because this system installation expenses are high and also. India is a traditional farming based country so the difficulties arises to adopt these kind of system in India. The agricultural land of country faces various problem like the farmers who are poor and not so financially strong cannot afford it, also the lack of knowledge

amongst people is again a reason. But by educating people towards new techniques and awareness can help to grow this system in upcoming future. These systems are closed type and the water gets recycled which is not used by plants. The farmer must know about the ability to grow indoor plants, and also control the temperature and lighting schedules to improve plant protection. Also hydroponics farms offer a pathway towards a more sustainable food, without using the chemicals which are harmful in the environment. Because in soil many chemicals are used to increase the yield of crop so food also have chemical properties in it. So hydroponics helps to grow and produce chemical free and healthy food.

MICRO IRRIGATION FOR HILL AGRICULTURE

Himanshu Tiwari
Department of Agronomy
SVPUAT, Meerut, (UP), India

Hill agriculture is characterized by its subsistence nature, sustainable approach, predominance of women farmers and rainfed farming areas. These hilly areas are the reservoir of huge amount of wild relatives of crop plants which act as potential source of good genes for crop improvement and can also prove to be the source of some of the underutilized nutritious crops and their gene pool. A focused and specialized approach for the development of agriculture in these areas is therefore the need of the hour.

Introduction

Agriculture use of water accounts for nearly 70% of the water utilised worldwide and the majority of this water is used for irrigation. Water is becoming increasingly scarce. With the ever-increasing competition for finite water resources and the steadily rising demand for agricultural commodities, there is need to improve the productivity and efficiency of water use for crop production. To ensure future food security and address the uncertainties associated with climate change. In north east India even though high rain fall is received (>2000 mm annually), there is water availability during November to April, which results very low leading to monocropping, water stress in the crops, and low yield. Out of 42 m ha m water resource of the region, only around 0.88 m ha m is used and rest is lost as run off to the lower reaches. As a result, there is excellent potential for rain water harvesting including farm ponds, roof water harvesting, in-situ harvesting, micro rain water harvesting structure like Jalkund etc. in the region for crop diversification and intensification and multiple livelihood opportunities. Rain water harvesting including surface runoff water harvesting and roof top water harvesting coupled with adoption of micro irrigation technologies such as drip and sprinkler is one of the best ways to conserve water and increase crop productivity. Rain water harvesting helps to provides an independent supply of water during scarcity period, provides life-saving irrigation during drought period, help in mitigating flooding in low lying areas, and reduces dependence on water storage such as dams, wells, etc. which may enable groundwater levels to be sustained. Drip irrigation maintains near perfect moisture levels in the root zone of plants, ensuring oxygen availability in the root system resulting in healthy fast-growing plants with increased yield. Well-managed micro irrigation system can save 30 to 70% of water and between 21-to-42-man days/ha of labour, with up to 100% water use efficiency compared to 30 to 40% under conventional practice. Micro irrigation systems can effectively be adopted in undulating land, rolling topographies, barren lands and shallow soils.

Micro irrigation

Fresh water resources for human use are becoming more and more scarce day by day. The present allocation of water to agriculture (90 per cent) is expected to be reduced to 75 per cent in the coming decade. Due to increasing demand for water from other uses like domestic, power generation and industries coupled with increase in standard of living, there is tremendous pressure, which necessitates scientific management of all available water resources. This can be achieved by development of new water resources, conservation and proper management of existing water resources. Increase in the water use efficiency is of foremost important and adoption of advanced irrigation methods like drip and sprinkler irrigation economises the use of irrigation water and double the irrigated area. Fertigation is a recent approach of applying fertilisers chiefly through micro irrigation. All the three major nutrients are applied in one solution directly to the plant root zone, thereby increasing the water and fertiliser use efficiencies. Therefore, fertigation is a sophisticated and convenient means of applying nutrients to crop plants that saves time, labour, energy, etc. This section describes the practical know-

how on drip irrigation and fertigation techniques, problems encountered and their solutions. Micro irrigation is the slow application of continuous drips, tiny streams or miniature sprays of water above or below the soil surface. In this Session, you will learn about the main features of micro irrigation system and its classification. Micro irrigation system is effective in saving water and increasing water use efficiency as compared to the conventional surface irrigation method. Besides, it helps reduce water consumption, growth of unwanted plants (weeds), soil erosion and cost of cultivation. Micro irrigation can be adopted in all kinds of land, especially where it is not possible to effectively use flooding method for irrigation. In flooding method of irrigation, a field is flooded with water.

Classification of micro irrigation system

Micro irrigation system can be broadly classified into two categories:

1. Drip irrigation system

Drip irrigation is one of the micro irrigation methods. The others include sprinkler, micro-sprinkler, mini-sprinkler, etc. Drip is a precise and regulated application of irrigation water and plant nutrients at low pressure over a period of time at short intervals through emitters/drippers with close network of pipes is known as drip irrigation system.

2. Sprinkler irrigation system

There are 10 major types of sprinkle systems. These are divided into two basic groups, namely set systems that operate with sprinklers in a fixed position and, continuous move systems that operate while the sprinkler is moving through the field.

Unique features of hill agriculture

1. Default organic agriculture.
2. Integration of livestock in agriculture.
3. Large variability in Climate.
4. Marginal land holding.
5. Predominance of women farmers.
6. Proneness to soil erosion and loss of soil fertility.
7. Socio-economic aspect.
8. Suitability for horticulture crops.
9. Rainfed agriculture.
10. Traditional crops.

Challenges in implementation of micro irrigation scheme

1. Delay in release of guidelines/government orders.
2. Free energy sources.
3. Inadequate promotional and information efforts.
4. Lack of dedicated team and IT backed operations.
5. Lack of easy financing mechanisms for farmers.
6. Poor integration with farm irrigation system.

Benefits of micro irrigation scheme:

1. Higher yield.
2. Higher profit.
3. Water saving & WUE.
4. Less energy cost.
5. Higher FUE.
6. Reduced labour cost.
7. Reduced soil loss.
8. Suitable for marginal soil & water.
9. Efficient & flexible.
10. Improved crop quality.
11. Crop inputs decrease.
12. Yield & quality increase.

Present challenges and recommendations for hill agriculture:

1. Use of information technology and dedicated team for process management.
2. Finance.
3. Focusing strategy for water intensive crops.
4. Stable scheme guidelines and their implementation.
5. Other approaches:
   - Construction of basic infrastructure coupled with institutional support would help in harnessing farming externalities.
   - Convergence of development activities will generate greater social benefits in hill agriculture.
   - Livestock production system should be strengthened with effective grazing policies.
   - Market led extension and market driven production may be envisaged in the developmental programs of hill states.
   - Regular brainstorming sessions should be organised for pragmatic hill agricultural planning.
   - Separate policies for hill agricultural need to be formulated.
   - Watershed development programs need to be expanded and upscaled with a separate watershed development policy and guidelines for the hill states looking to the peculiar nature of hill states.

DID YOU KNOW?

Ragi, Foxtail Millet, Bajra and Barnyard Millet are heating millets which means they should ideally be consumed during the winter season.

INTERNATIONAL YEAR OF MILLETS 2023

ADJUSTMENT, OPERATION AND MAINTENANCE OF THRESHER

About Author ...

Er. Shankar Singh
SMS (Agricultural Engineering)
KVK, Madhubani, Bihar (India)

Threshing is an operation of detaching the grains from the ear heads, cobs and pods. Thresher is a machine to separate grains from the harvested crop and provide clean grain without much loss and damage. During threshing, grain loss in terms of broken grain, un-threshed grain, blown grain, spilled grain etc. should be minimum. Bureau of Indian Standards has specified that the total grain loss should not be more than 5 per cent, in which broken grain should be less than 2 per cent. Clean unbruised grain fetch good price in the market as well as it has long storage life. Thus the effective threshing operation means that the loss of unthreshed kernels ejected with the straw through the concave of threshing and loss of grain damage should be low and amount of material passed through the concave should be high. Threshing wheat by traditional method involves drudgery and takes more time to obtain required quality of bhusa. Due to these, mechanical threshers are widely accepted by the farmers.

Component of a thresher

A mechanical crop thresher mainly consists of the following component/ devices:

a) Feeding device (chute/ tray/ trough/ hopper/ conveyor).
b) Threshing cylinder (hammers/ spikes/ rasp-bars/ wire-loops/ syndicator).
c) Concave (woven-wire mesh/ punched sheet/ welded square bars).
d) Blower/ aspirator.
e) Sieve-shaker/ straw-walker.

Adjustments in threshers

Various adjustments are required before starting threshing operation. The machine is to be installed on clean level ground and is to be set according to crop and crop conditions. The adjustments necessary to get best performance from the machine are (i) concave clearance, (ii) sieve clearance, (iii) sieve slope, (iv) stroke length and (v) blower suction opening. Besides these, cylinder concave grate, top sieve hole size and cylinder speeds for threshing different crops are important for a multi crop thresher.

Adjustments before operating a thresher:

1. Position the thresher on a level area close to the crop stack to minimize handling and shattering losses.
2. Spread cloth, canvas, or mat underneath the thresher to collect spilled grain from the grain discharge chute or due to shattering during handling.
3. Install the cylinder, cover, and feed tray if dismantled during field transport.
4. Position the thresher so that the straw is thrown with the direction of the wind. This will eliminate the blowing of straw, chaff, and dust back toward the operator and the threshed grain.
5. Check each belt's alignment and tension. Adjust the idler pulley on the blower/cylinder belt to correct tension. Improper alignment and tension are the major causes of premature belt failure. (Fig: 5.)
6. Check pulley surfaces. Rough grooves must be smoothened with a fine file if nicked. Cracked pulleys should be replaced immediately. (Fig: 5).
7. Open the cover and check all pegs on the threshing cylinder for tightness. Loose pegs will damage the machine and can be dangerous to the operators. (Fig: 6.)
8. Examine the peg teeth for wear. Maximum wear occurs at the feed end of the cylinder and is more prominent at the leading side in the direction of rotation. Worn pegs must be rotated 180 degrees or interchanged with those located near the straw paddles. Badly worn pegs must be replaced or rebuilt by welding.
9. Rotate the threshing cylinder manually at least five revolutions to ensure that there are no obstructions or interferences.
10. Make sure there are no loose or missing bolts and set screws. Tighten or replace as necessary.
11. Lubricate all bearings with good quality grease (see maintenance and service section) the belt idler and oscillating screen eccentric bearings are lubricated for life, thus require no lubrication.
12. Check engine oil and fuel levels. Follow the engine manufacturer's recommendations.
13. Start the engine and allow it to warm up.
14. Feed the thresher with the crop to be threshed for performance checking. Increase cylinder speed if excessive amounts of unthreshed and unseparated grain are observed with the straw.
15. Optimum threshing and cleaning is obtained with cylinder speeds of 600 to 700 rpm.

Safety precautions in threshing operation:

1. Leave all guards and shields in place when operating the machine.
2. Before cleaning, servicing, or repairing the machine, disconnect the power to the unit.
3. Use only properly grounded outlet (electric only).
4. Keep hands out of threshing belt entry area.
5. Do not wear loose clothing when operating this machine. Clothing can be grabbed by chain drives or rotating shafts and severe injury can result.
6. Keep hands and feet away from chain drives and v-belts when machine is running.
7. Lock brake when using (if equipped).

Guide lines for maintenance of a crop thresher:

1. Lubricate cylinder and fan bearings with good-quality general purpose grease every 25 hours of operation. Periodically apply a small amount of oil to all hinge points.
2. Inspect the machine regularly for loose, worn, or damaged peg teeth, concave bars, cylinder, discharge paddles and other parts, and tighten, repair, or replace them immediately. Missing bolts or nuts must also be replaced.
3. Reduce belt tensions by loosening the idler pulley and engine mounting bolts when the machine will not be used for an extended period to minimize deterioration.
4. Check engine crankcase oil level at least every 4 operating hours and follow the engine manufacturer's recommendations for oil change intervals and oil grade. Be sure the recommended oil level is maintained.
5. Service the air cleaner, fuel filter, fuel line, carburetor, and spark plug regularly according to engine manufacturer's instructions.

Guide lines for storage of a threshing machine

1. Clean the machine thoroughly.
2. Remove belts and store in a dry place.
3. Store the machine in a clean, dry location and cover to reduce damage from dust accumulation.
4. Paint parts that need repainting.
5. Clean and apply oil to exposed metal surfaces to prevent rusting.
6. Follow the manufacturer's recommendations on engine storage.■

DID YOU KNOW?

INTERNATIONAL YEAR OF MILLETS 2023

Little Millet and Proso Millet have cooling properties and can be eaten during the summer season.

Mr. Khadar Vali is known as Millet Man of India, he has been living on Millet for the last 25 years.

INTERNATIONAL YEAR OF MILLETS 2023

MODELING AND SIMULATION OF PEST INCIDENCE FOR FOREWARNING

About Author ...

Sheenam Bhateja*
Sachin
Ph.D. Research Scholar
Deptt. of Entomology
Rajasthan College of Agriculture,
MPUAT, Udaipur

From the 1960s, the scientists started using computers for scheduling the spray, exploring control strategies and managing pest monitoring data. Recently, utilization of computer application is explored in pest management delivery systems and decision support systems (DSS) designed to enhance decision making. In the area of plant protection, computers are useful in myriad ways: a) storing, retrieving and analyzing data such as survey, surveillance and maintenance of pest incidences b) Modeling and simulation of pest incidence/forewarning c) Developing, Decision Support Systems/Expert systems to pest problems leading to decision making. Simulation is the initation of the operation of a real-world process or system over time. The act of simulating something initially requires that a model be developed; model represents the key characteristics or behaviors/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. Severity of infestations of the insect pests and diseases differs b/w seasons, regions and individual crops within a region. In the absence of stable, desirable and diverse sources of resistance to the biotic menace, pesticides remain the only effective means to manage them. Knowledge about the timing of start of infestation of these pests and their gradual progress in advance could enable plan necessary pesticide schedule for the season, region on the particular crop against the specific menace expected. This could be enabled by development of region, crop and pest-specific prediction models to forewarn these menaces. Since these biotic menaces are weather-dependent, weather-based prediction models could be developed to enable manage these pests. Forecast model devising consumes a lot of resources viz., manpower, time etc. Hence, it is important that such resources are provided only to an important crop. The candidate pest should be sporadic and its occurrence, severity, progression should be influenced by weather factors and hence should vary accordingly, should cause economically significant yield losses over large area and availability of timely and quality forecast could enable mitigate the risks due to the occurrence of the same by application of effective economic prophylactic measure. Pest must be potential to cause damage.

1. Types of models

If data is available at periodic interval for 15-20 years, the detailed study can be carried out for different variables of interest. However, depending upon the data availability, different types of models can be utilised for developing forewarning system. The models could be of two types- Between year model and Within year model.

1.1 Between year models

These models were developed using previous years data. An assumption is made that the present year is a part of the composite pop of the previous years and accordingly the relationships developed on the basis of previous data will be applicable for the present year. The forecast for pests are obtained by substituting the current year data into the model developed upon the previous years.

1.2 Within year model

Sometimes, past data on pests are not available but the pest status at different points of time during the crop season are available for the current season only. In such situations, within years growth model can be used for forewarning max pest pop, provided there are 10-12 data points b/w time of first appearance of pest and max or most damaging stage.

2) Some popular application of successful models in pest monitoring and control

- **Wireless Sensor Network based Forewarning Models for Pests and Diseases in Agriculture in Groundnut-** Calculated DDs serve as the base to predict whether the pest is in egg or larval stage and thus assists in timing pesticide sprays.

- **CLIMEX simulated predictions of oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) geographical distribution under climate change situations in India-** CLIMEX uses two constraints to estimate the

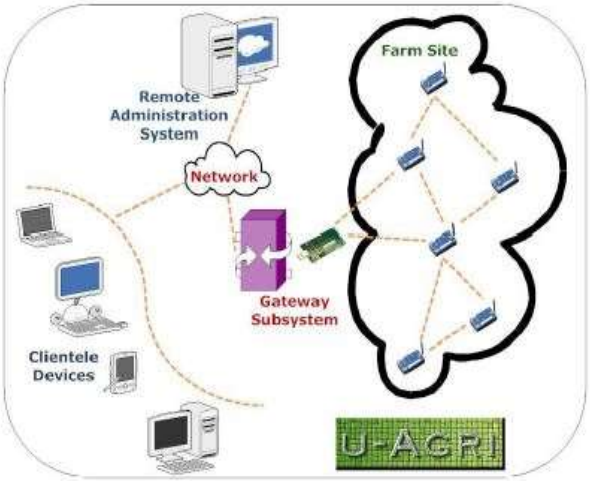


Fig. 1: u-Agri System Architecture

potential growth and survival of a population at a given location, i.e. growth (mainly temperature and soil moisture) and stress indices (cold, heat, wet and dry stress). The values of these two indices are clubbed to generate the eco-climatic index (EI), generally scaled between 0 and 20. An EI close to 0 indicates location not favourable for long-term survival of a species and EI nearer to 20 as highly suitable.

- Assessing aphid infestation in Indian mustard under present and future climate scenarios.
- Spatial dynamics of *Helicoverpa* populations in Australia: simulation modelling and empirical studies of adult movement.
- **Simulation model of *Rhyzopertha dominica* population dynamics in concrete grain bins-** Population density was predicted to be highest in the top center of the bin. The reasons for this are: (1) immigration rates are highest in the top layers of the grain and decrease exponentially in subsequent layers. (2) the periphery of the grain mass cools faster than the center, so pop growth is slower in the periphery.

3) Some other models

Model	Insect pests
Spatially-explicit	Cereal aphid
Pest-Weather Regression	Rice BPH
PENNA	*Aphis gossypii* & parasitoid (*Lysiphlebus testaceipes*)
Med –fly	Mediterranean fruit fly
FENOVITIS	European grapevine moth
Insect Life Cycle Model (ILCYM)	Potato tuber moth
PHENIPS	Bark beetles on spruce trees

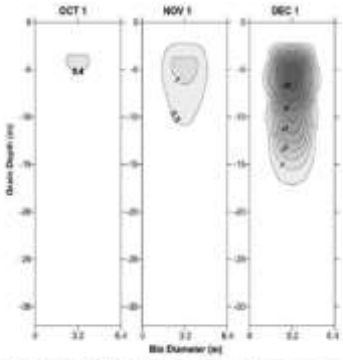


Fig.2. Predicted *R. dominica* population density (insects/kg) and spatial distribution over a 4-month period (September, October, November, and December). The cylindrical concrete bin was 6.4m wide x 21m tall.

Conclusion

Forecasting the peak abundance of pest and diseases in advance helps in timely management of crop pests. The correlation and multiple regression analysis clearly showed the importance of weather factors in predicting the pest and diseases incidence. Bioeconomic, process-level simulation models are effective tools for integrating multiple crop stresses and for evaluating management strategies.

SOIL COMPACTION

CAN BE A SERIOUS FORM OF SOIL DEGRADATION IN SUSTAINABLE AGRICULTURE, CAUSES AND MANAGEMENT

About Author ...

Nunavath Umil Singh
Yerradoddi Sindhu Sree
Surla Pradeep Kumar
Ph.D., Research Scholar
Deptt. of Agronomy
Banoth Madhu
Ph.D., Research Scholar
Centre for Plant Breeding and Genetics
TNAU, Coimbatore (T.N.)

Soil compaction is a dynamic behaviour of the soil, where the process of Increasing the density of the soil by the applied effort. Soil compaction can be a serious and unnecessary form of soil degradation that can result in increased soil erosion and decreased crop production. Compaction of soil is the compression of soil particles into a smaller volume, which reduces the size of pore space available for air and water. Most soils are composed of about 50 per cent solids (sand, silt, clay, and organic matter) and about 50 per cent pore spaces.

Concern about compaction and effects

Water infiltration into the soil, crop emergence, root penetration, and crop nutrient and water intake can all be hampered by soil compaction, which lowers crop output. Human-induced compaction of agricultural soil can be the result of using tillage equipment during soil cultivation or result from the heavy weight of field equipment. Compacted soils can also be the result of natural soil forming processes. Solonetzic soils are an example of natural soil compaction. Soil particles can become compacted closer together into a smaller volume due to the various forces of soil compression by agricultural equipment. The space between particles (pore space) is reduced as particles are compressed together, reducing the space available in the soil for air and water. The crushing of soil

aggregates by the compaction force has an adverse effect on the structure of the soil aggregates.

Soil compaction can have several negative impacts on soil quality and crop production including the following:

1. Causes soil pore spaces to become smaller.
2. Reduces water infiltration rate into soil.
3. Decreases the rate that water will penetrate the soil root zone and subsoil.
4. Increases the potential for surface water ponding, water runoff, surface soil waterlogging and soil erosion.
5. Reduces the ability of a soil to hold water and air, which are necessary for plant root growth and function.
6. Reduces crop emergence as a result of soil crusting.
7. Impedes root growth and limits the volume of soil explored by roots.
8. Limits soil exploration by roots and decreases the ability of crops to take up nutrients and water efficiently from soil.
9. Reduces crop yield potential.

Soil compaction can reduce soil aeration and cause denitrification, which increases nitrate nitrogen loss, particularly years that are wetter than usual, which is the conversion of plant available nitrate-nitrogen into gaseous nitrogen forms that are lost to the atmosphere. This process occurs when soils are in an anaerobic condition and soil pores are mostly filled with water. Reduced soil aeration can affect root growth and function, and lead to increased risk of crop disease. All these factors result in increased crop stress and yield loss.

Types of soil compaction

I. Surface soil crusting compaction- by combination of soil tillage and raindrop or irrigation water impact.

Causes: Soil tillage can bury much of the protective residue cover on the soil surface and degrade the granular structure of surface soils (mechanical crushing or breaking of larger soil aggregates). The impact energy of rainfall or irrigation droplets can also cause considerable degradation and breakdown of soil aggregates, causing soil particles to become suspended in water, flow together and then dry into a hard surface soil crust. The crusted soil can restrict water infiltration into soil and restrict the emergence of germinating crops.

Figure- Soil crusting can severely reduce crop emergence

Management: The best way to prevent soil crusting in fields is to both minimize tillage operations and ensure that a protective layer of residue remains on the soil surface to absorb the impact of water droplets before they strike and break down stable soil aggregates by reduced tillage. These methods leave greater amounts of residue on the soil surface to reduce soil crusting and increase soil organic matter levels, leading to improved surface soil structure. Using crop management practices such as including a forage in the crop rotation or using direct seeding practices to increase the levels of soil organic matter will aid in the development of a good granular-structured soil that has greater resistance to breakdown.

II. Subsurface soil compaction: Hardpan tillage or induced compaction

A tillage-induced compaction layer is sometimes referred to as a **"hardpan"** or **"plow pan"** and occurs in the layer of soil just below the depth of tillage. It occurs when soils are cultivated repeatedly at the same depth. The weight of the tillage equipment, such as discs or cultivator shovels, can cause compression of the soil and smearing at the base of contact between the soil and tillage implement. Usually, the compacted layer is about 2 to 3 cm thick.

Management: When compacted soil persists, the soil may need some form of tillage to physically break up the hardpan. When soils are relatively dry, use a heavy-duty cultivator with spikes to penetrate just below the hardpan to fracture and break it up. It is important to note that tillage may reduce the hard pan compaction problem, but it may not address the sources of the problem. It may take three to five years of reduced tillage or direct seeding practices, freeze-thaw cycles. The use of a combination of taproot and fibrous-rooted crops to correct the hardpan problem. To avoid the development of a tillage-induced hardpan, land should be direct seeded to minimize tillage of the soil. For land seeded to row or root crops, where tillage is required, soils should not be worked when wet.

III. Wheel traffic-induced compaction

Heavy farm equipment, including tractors, grain carts, combines, trucks, manure spreaders and wheels of pivot

irrigation systems, can exert considerable weight onto the soil surface and, consequently, into the subsoil. The effect of equipment weight can penetrate down to 60 cm (24 inches) when soils are moist. Correction and Prevention; Wheel traffic-induced compaction can be managed using good agronomic practices, deep tillage, or a combination of both. Ideally, it is best to use agronomic practices both to prevent and correct wheel traffic compaction.

Ideal management practices to prevent soil compaction

To manage soils and crop rotations to prevent the development of compacted soils through good agronomic management and by implementing basic soil conservation practices. reduced tillage or direct seeding practices, which leave greater amounts of residue on the soil surface, will reduce soil crusting and will increase soil organic matter levels. Direct seeding will also aid in increasing soil organic matter and help develop a good granular-structured soil that has greater resistance to aggregate breakdown. Direct seeding will eliminate the need for soil cultivation, which is the primary cause for development of a hardpan or plow pan layer.

Controlled traffic farming is a new cropping system practice in which tramlines are set so that all farm machinery traffic travels in the same wheel tracks in a field. The system separates the tramlines from the crop areas. As a result, the traffic lanes where all machinery travels are permanently set up within a field. Promotion of the controlled traffic farming concept suggest the following benefits: reduce overall soil compaction in a field, improve soil structure, increase water infiltration, increase soil water storage, increase moisture use efficiency, and improve nutrient use efficiency.

Using diverse crop rotations, which include forage, cereal, oilseed and pulse crops that vary in rooting depth and type (fibrous versus taproot), combined with good agronomic management practices, such as direct seeding will help reduce soil compaction issues. Good cropping practices will help in several ways; Promote plant roots to grow through and break up compacted soils, increase soil organic matter, improve soil structure, improve water infiltration and penetration into soil, and promote biological diversity A biologically healthy soil will be more resistant to soil compaction.

Summary

Soil compaction is not considered a widespread, serious problem in agriculture. Preventing soil compaction is far superior to attempting to correct a compaction problem after it has occurred. Several management options can be implemented to minimize the risk of soil compaction; Place a protective residue cover on the surface of soil to reduce the negative impact of rain or irrigation water causing soil crusting. Minimize or eliminate soil tillage to prevent soil aggregate breakdown and induce the development of a tillage "hardpan" – this goal can be achieved by direct seeding and the elimination of soil cultivation. As far as possible, avoid field traffic when soils are wet; this is more easily said than done, for example, when harvest schedules dictate the crop must come off despite wet field conditions. Reduce the wheel traffic load on the soil, which can be done by keeping axel loads to a minimum. Use radial tires at low inflation pressures to create a larger footprint.■

PUSA's BIO-FERTILIZERS AND THEIR FORMULATIONS

About Author ...

Brunda B. N.*
Syam S.
M.Sc (Agri.)
Division of Microbiology
ICAR-IARI, New Delhi

Soil infertility is the most fundamental barrier affecting agricultural productivity in developing countries globally, especially among resource-poor farmers. As a result, preserving soil quality can help to alleviate the issues of land degradation, decreased soil fertility and rapidly declining output levels that plague many regions of the world that rely on basic principles of sound agriculture practices. Thus, bio fertilizers can play an essential role in integrated nutrition management. Nitrogen fixers, potassium mobilizers and phosphorus solubilizers are often exploited as biofertilizer components as are molds or fungus. As eco-friendly and cost-effective inputs for farmers, these prospective biological fertilizer would play an important role in soil production and sustainability whilst still protecting the environment.

Introduction

Biofertilizer can be defined as biological products containing living microorganisms that when applied to seed, plant surfaces or soil promote growth by several mechanisms such as increasing the supply of nutrients, increasing root biomass or root area and increasing nutrient uptake capacity of the plant.

PUSA microbial formulations:

Division of Microbiology, ICAR-IARI, New Delhi produces various formulations of bio fertilizers. As the formulations are developing in 2 forms

namely Powdered formulations and Liquid formulations.

A) Powder formulations: Powder / carrier based formulations are viable untill 6 months, with cell count as high as 10^8cfu/ml. Carrier materials like talc, bentonite, lignite, charcoal powder and rice husk.

Method of usage for powder formulations:

Dissolve 100g gur / sugar in 1L of water by boiling make slurry with this powder. Pour the slurry on seed for 1 acre.

1. Pusa *Mycorrhiza* biofertilizer: It can be used on all crops, flowers, fruits and vegetables.

2. Pusa *Azatobacter* inoculant: It can be used for various crops, charcoal based, each pack weighs about 200g.

3. Pusa *Azospirillum* inoculant: Help non leguminous crops such as Sorghum, Maize, Bajra and Ragi. In case of Sugar cane 5-8 packets in 15-20L slurry. Dip the sugar cane sets not less than 5 minutes before sowing. At the time of earthing operation 10 packets into 40 kg FYM.

4. Pusa Bioiron inoculant: It can be used for various crops. It is helpful to make available iron to plants.

5. Pusa *Rhizobium* inoculant: Help leguminous crops such as moong

6. Pusa *Microphos* inoculant: It can be used on all crops, flowers, fruits and vegetables. It is helpful to make available phosphorous to plants.

B) Liquid formulations: Liquid formulations are viable until 20-24 months, with cell count as high as 10^{12}cfu/ml.

Method of usage for liquid formulations: Pour 50 ml formulation in 1L water then soak plant parts or seedling roots and air dry.

Pusa Bio iron, Pusa Bio zinc, Pusa Bio potash, Pusa Biophos these are helpful to make available iron, zinc, potassium, phosphorous respectively to plants.

Pusa Sampoorn: It is helpful to make available Nitrogen, phosphorous and potassium to plants. PUSA Sampoorn is an eco-friendly biofertilizer having consortium of 3 bacteria with properties of fixing atmospheric N to ammonia and solubilization of unavailable P and K in soil to make it available for plants. The liquid formulations have longer shelf life and support larger counts of the bacteria. This liquid formulation has shown an improved plant growth and enhancement in N, P, K uptake by various crops tested.

Pusa decomposer:

Pusa decomposer technology is a microbial-based strategy (liquid formulation & capsules) which degrades the waste (pit or windrows) and converts into nutrient-enriched compost. This is an eco-friendly and environmentally useful technology in true with the Govt of India's "Swatch Bharat Mission".

Conclusion:

Biofertilizers boost agricultural production by increasing BNF, improving nutrient availability or uptake by solubilization or higher absorption, stimulating plant growth through hormonal action or antibiosis or decomposing organic wastes. Furthermore, adopting biofertilizer to replace a portion of the usage of chemical fertilizer reduces the volume and expense of fertilisers preventing contamination from the widespread use of chemical fertilisers.■

INNOVATIVE APPROACHES FOR SOIL HEALTH

Numerous activities in a healthy soil promote plant growth, such as nutrient cycling and biological control of plant pests. These days, soil health is a popular topic that is deservedly gaining a lot of attention from growers and their farm advisors. The biology of the soil is crucial to its general health and productivity, contrary to previous research that placed a greater emphasis on chemical and physical factors in soil testing and evaluation. In order to increase the resilience of their working land, producers can work with the ground rather than against it by managing for soil health.

Soil health: Why should we care?

Producing enough food to support an expanding human population is impossible without productive and healthy soil. Around the world, there are numerous degraded soils that are no longer productive and can only be

About Author ...

Sugandha Chauhan
PG Student
Soil Sci. & Agril. Chem.,
ANDUAT, Ayodhya (U.P.)

Dr. Sandeep Yadav
Assistant Professor
Shri Ram Swaroop Memorial University, Lucknow (U.P.)

Utkarsh Singh
Agronomy
Soil Sci. & Agril. Chem.,
ANDUAT, Ayodhya (U.P.)

restored to a productive state by using soil health principles. According to global trends, soil degradation is responsible for a consistent reduction in productivity on 20% of cropland, 16% of forest land, 19% of grassland, and 27% of rangeland. It is imperative to generate a crop and soil management system that enhances and retains soil health over time by understanding how control strategies affect the soil processes that support plant growth and regulate environmental quality.

What is soil health?

"Soil health" can be described as "the state of the soil being in sound physical, chemical, and biological condition, having the ability to sustain the growth and development of land plants." The capacity of soil to function as a vital living system, within ecological and land-use boundaries, to support plant and animal productivity, improve water and air quality, and promote plant and animal health is a precise definition of soil health.

New approach

1. **Mitigate impact on soil health-** Encourage integrated pest management (IPM). Use of targeted and synthetic biocide. Support tactics of non-chemical control. Protection from natural enemies.
2. **Management of soil environment to enhance pest and diseases resistance-** The soil community can be managed in combination with genetics to harness the disease and pest attack. Predator-prey interaction and nutrient cycling is desirable such as pheromones, semi chemicals, non-lethal synthetic molecule, etc.
3. **Conservation management practices –** Cover crops, reduced tillage and diversified cropping system can be incorporated during cropping season. Utilization of on-farm innovation and local management techniques. Combat the pest challenges through innovative approaches that frequently occur with soil-health based practices.
4. **Sources of Nutrient Diversification-** Plants can get the nutrients they require from the soil naturally or by applying them externally in the form of organic, inorganic, or microbial inoculants. The utilization of green and brown manure has a significant and positive effect on soil health with their contribution to yield improvement and saving on the application of chemical fertilizers.
5. **Integrated Farming System for Resource Cycling-** The utilization of farm resources and their reuse in production systems can be made possible by the integrated farming system (IFS) strategy, which involves the integration of multiple businesses that support the primary business. Farmers can easily accept this resource-cycling through IFS because it is associated with financial gain, and the alternative also improves soil health.
6. **Utilization of effective soil amendments-** By improving soil properties like aggregation, porosity, and infiltration rate, replacing exchangeable sodium concentration from exchange complexes and bringing the pH in the neutral range, the application of soil amendments for the correction of sodic soil has a significant and beneficial impact on the health of the soil. The use of liming materials in acidic soil results in decrease in the poisonous concentration of metal elements like Fe, Mn, and Al, an increase in the availability of phosphorus, calcium, magnesium, and potassium as well as an increase in the activity and variety of soil microbes.

■■■

BIOCHAR PRODUCTION TECHNOLOGY

PROPERTIES AND ITS APPLICATIONS

About Author

Pallavi Bharti*
Ph.D. Scholar
Birsa Agricultural University, Ranchi, Jharkhand

Pankaj Kumar Ray
Subject Matter Specialist
KVK, Saharsa, Bihar

The word char is a commonly utilized for the by-product of combustion process of plants material. Biochar mainly consist with high carbon content e.g. charcoal. Biochar is mainly produced from the thermochemical conversion process of biomass. It is an important product in the soil, food, and agricultural sectors. Pyrolysis method widely practiced to the production of charcoal from wood material. The properties of biochar are affected by several factors which are heating rate, heating type, temperature, and composition of materials, particle size, and reactor conditions. Biochar main components are volatile matter, ash, carbon, and moisture. The composition content of biochar is mainly depending on the feedstock material and the operating parameters. Biochar from wood and other plants materials have higher carbon content (minimum 51%). Biochar has been utilize for various purpose like as soil amendment, to

generate energy, to treat west water treatment, Carbon sequestration and mitigation of climate change, adding to increase the soil nutrients, and applying to improve the soil properties.

Biochar production technologies:

Conversion of plant material into carbon is known as biochar production. By using waste materials, improved the biochar production techniques can contribute to fulfill the demand of energy needs of the future and enhance the soil carbon sequestration potential. Three technologies mainly utilize for the production of biochar which is namely pyrolysis, pyrolysis, carbonization and gasification.

Pyrolysis:

It is thermochemical conversion of biomass into the biochar, bio oil and syngas under the absence of oxygen with the temperature ranging 400 ˚C to 1200 ˚C on the basis of time consuming into the process pyrolysis divided into three broad categories (1) Fast pyrolysis (2) Intermediate pyrolysis and (3) Slow pyrolysis.

A. Slow pyrolysis: Slow pyrolysis has taken long time, more than one hour and its major output is biochar. Slow pyrolysis is traditional pyrolysis technique, where wood and other materials are heated at higher temperatures at 300 to 600°C with 5-7 °C/ minute heating rate. Low heating speed and longer vapor residence time provide favorable environmental condition the secondary reactions to proceed. This process leads to formation a solid carbonaceous biochar at the end of process. In the slow pyrolysis biochar is major product which is 35 to 45% and other products like bio-oil 25 to 35% and syngas 20 to 30% are produced.

B. Fast pyrolysis: The fast pyrolysis process competes within few seconds or less. During the process solid biomass converted into biofuel, solids and gases produced. Fast pyrolysis is carried in the absence of oxygen at high temperatures more than 500°C with heating rate more than 300°C/minute. In the fast pyrolysis produces bio oil 60%, biochar 20% and 20% syngas.

C. Intermediate pyrolysis: Intermediate pyrolysis is a combination of slow and fast pyrolysis methods for the production of biochar. Intermediate pyrolysis is very important to the production of solid and liquid products. Intermediate pyrolysis occurs at 500 and 650°C temperature with heating rates between 0.1 and 10°C/minutes. In the intermediate pyrolysis produce 40 to 60% liquid, 20 to 30% non-condensable gases and 15 to 25% biochar.

Gasification:

Gasification is a thermo-chemical conversion process in which biomass converted into combustible gases at higher temperature (more than 700°C) under low amount of oxygen. Produced gas generally known as syngas. The composition of syngas is hydrogen (H_2), methane (CH_4) and carbon monoxide (CO).

Carbonization:

In the carbonization process organic substances are converted into high carbon material. It represents different pyrolytic processes; this is similar to conventional methods which are used for charcoal production. The carbonization process is complete between 280°C to 500°C temperature. In the process of carbonization charcoal is the main produce and also produces some combustible and non-combustible gases.

Applications of biochar:

Charcoal is important organic material at the present time charcoal widely utilize in deferent sectors like apply as soil amendment, apply for the west management and it is also apply to carbon sequestration and mitigation of climate. The following important use applications of carbon as follow:

Application for waste management: Every year large amount of waste material is generated from the various sources, like wheat and rice straw, rice husk etc), wood based industry wastages industrial, fruit and vegetable industries wastages, forest logging and animal wastages. All waste material are utilize for the biochar production with different techniques. production of biochar from the all waste material it is help in the achieving two different objectives first one is minimize the pollutant material and second is production of energy. In addition, it is also helps in mitigation of greenhouse gases emissions.

Biochar application for soil amendment: Biochar is a good soil amendment. It has ability to improve the quality of soil. Biochar helps in increase the water holding capacity of soil and retention period of water into soil. Biochar are also helpful for the increase the soil pH to acidic soil increased Cation exchange capacity and nutrient use efficiency of the soil.

Carbon sequestration and mitigation of climate change: Biochar production has proved to be one of the best ways to sequester the carbon dioxide from the environment. As carbon removed by the various plants from the environment during its life cycle and stores permanently it in its structure. This method does not lead to straight sequester the carbon from the atmosphere but it converts biomass carbon into a highly stable form thereby decreasing CO_2 emission from soil due to decomposition.

Application for west water treatment: Biochar is most important substance which is utilize to the remove organic substance, due to high porosity and large surface area of biochar. Biochar provide high surface area for the contaminants and impurities to interact with the active site of the biochar. Biochar mostly utilize to remove of organic compound of chlorine, certain metal, volatile compounds, pesticides, etc.

Application for energy generation: Biochar can be used as a substitute of coal for energy production. It is cheapest way to producing electrical energy from biomaterial by using the pyrolysis method. Also, syngas produced as a by-product during biochar production can be used as a fuel in gas engines. Bio-oil can be used as a replacement for fuel oil.

Conclusion:

Biochar is produce by the west material of plant and production of biochar is important because of through the production of biochar west material is easily managed and it is also help to manage the pollutant martial from the various agriculture crops. Positive effects of biochar was noticed on agriculture and agroforestry systems, like soil health improved, improve plant growth performance, carbon sequestration and minimize greenhouse gases, it is ultimately improve the agriculture crops yield.

■■■

BIOCHAR

A QUALITY ENHANCER FOR FRUIT CROPS

About Author ...

Reetika Sharma
Ph.D. Scholar
Division of Fruit Science,
SKUAST-Jammu, Chatha (J&K)

Pyrolysis is the term for the heating of biomass, such as wood, plant or animal waste, or leaves, in a closed container with little to no available air. Biochar, a very inexpensive "input" in the production of horticulture, is the outcome of the pyrolysis of biomass. It can be generated from any ligno-cellulosic biomass, including brushwood, waste from the harvest of timber, crop leftovers like rice and wheat straw, weedy shrubs and grasses, as well as animal manure. In addition to highlighting the need for in-depth field research to completely understand how biochar affects biological N_2 fixation, this article highlights the potential for employing biochar in horticulture applications to improve N input and also show that biochar from biomass not only results in the production of renewable energy (synthetic gas and bio oil),but it also reduces the amount of carbon dioxide in the environment.

Advantages

1. The use of biochar in agricultural practises is a promising new technology with tremendous potential to maintain and enhance soil quality and nutrient cycling.
2. Biochar is a novel and intriguing supplement to increase yield on acidic, degraded soils with low fertility.
3. A potential successor termed as biochar has the ability to improve the physical, chemical, and biological properties of soil.
4. Adding biochar to the soil results in better soil pH, nutrient availability, moisture absorption, and carbon sequestration.
5. By stimulating soil microbial activity, biochar increases soil fertility and water-holding capacity, which in turn encourages crop growth and yields.

Effects of biochar in fruit crops

Mango: Under saline environments, biochar helps plants grow and develop their physiological and biochemical characteristics. The crop production and productivity increased along with the plant height and potassium uptake when biochar was added to the saline soil. Additionally, it is done to alter the nitrogen cycle, lower emissions of nitrous oxide from the soil, and increase carbon sequestration. By improving the physical and chemical qualities through sodium filtration and lowering its concentration in the soil, it is also helpful in lessening the effects of salt stress. Due to its strong capacity to absorb contaminants, it may have a significant impact on soil CO_2 emissions and enhance the quality of polluted soil. Harhash *et al*. (2022) performed an experiment on the performance of mangos as impacted by the soil application of zeolite and biochar under salinity stresses. The results showed that the application of zeolite or biochar had a favourable impact on soil properties, which had an impact on the tree's trunk thickness, shoot length and width, number of inflorescences, yield in kg per tree, and fruit quality.

Citrus: Microorganisms are an essential aspect of the soil ecosystem and the primary catalyst for the physical and chemical processes that take place there. Biochar's unique physical and chemical characteristics enable it to offer nutrients as a food source and natural habitat for microbes. Zhang *et al*. (2022) studied on biochar amendment improved fruit quality and soil properties and microbial communities at different depths in citrus production. The application of biochar had a favourable impact on the citrus fruit indexes (peel, edibility, soluble solid-to-titratable acidity ratio, soluble solids) and soil

physicochemical qualities (pH, organic matter, nutrient elements). Biochar considerably increased the richness, evenness, and variety of soil bacteria while decreasing the evenness of fungi in terms of microorganisms. Beneficial bacteria were enhanced by each biochar treatment. In addition, once biochar was applied, saprophytic fungi that can encourage nutrient cycling were greatly enriched.

Banana: Application of biochar as an amendment to salinesodic soil ameliorates the effects of potential stressors on plant performance and production**.** In an experiment on the effects of biochar on the vegetative parameters, leaf mineral content, yield, and fruit quality of the Grande Naine banana in saline-sodic soil, Ogiala (2018) came to the conclusion that higher biochar addition rates resulted in better growth, productivity, and fruit quality. With a wood sawdust biochar rate of 20 mg ha^{-1}, the pseudostem's length and girth, the leaf area, as well as the bunch, cluster, and finger weights, all saw significant increases.

Papaya: Biochar application significantly increased shoot and root growth as well as soil chemical characteristics in papaya plants. A rapid initial rise in plant height was made possible by the use of biochar and biochar combined with mucuna. Despite the enhanced N, P, K, Ca, and Mg accumulation and usage efficiency in the plants, it also revealed a clear N deficit. The combined application of mucuna and biochar increases plant height and the P content of the leaves. The papaya plant grows and nourishes more readily when charcoal and mucuna are applied separately or together, and soil fertility is preserved.

Strawberry: According to Shang, 2019 concluded that although it was predicted that the application of wood-based biochar would boost strawberry yield and quality (average fruit weight, TSS, TPC, and antioxidant activity), the only thing this practise actually did was increase average fruit weight.The greater average fruit weight in biochar-treated crops may be attributed to an enhanced chemical sorption of essential nutrients such as N, P, and K to the wood-based biochar surface that improved nutrient absorption by plant roots during the fruit development and ripening periods.

Apple: Apple trees had larger trunk diameters and more shoots overall. However, there were no appreciable changes in the productivity indexes of fruitfulness, fruit weight, or starch pattern index.

Conclusion:

In a wide number of areas, biochar is developing as a very promising, ecologically beneficial material. As a result, it's essential to create standard biochar characterization techniques that incorporate the contributions of all scientists who have used biochar. As a first step, a global meeting that considers biochar's characteristics would be beneficial. Reclaiming the soil is crucial to overcoming wastelands. Therefore, the article on the use of biochar in fruit production offers a strong foundation for future research and might make it easier to use biochar to increase fruit production.

■■■

HORNED MELON
(*Cucumis metuliferus* E. Meyer Ex. Naudin)
AND ITS BIOLOGICAL BENEFITS

Muzeev Ahmad*
Ph.D. Scholar
Deptt. of Horticulture
Khursheed Alam
Ph.D. Scholar
Deptt. of Veg. Sci.
Amit Kumar
Ph.D. Scholar
Deptt. of Fruit Science
Falak Fayaz
M.Sc. Student
Deptt. of Plant Pathology
SVPUAT, Meerut (U.P.)

Horned melon or kiwano (*Cucumis metuliferus* E. Mey. Ex. Naudin) is a fruit rich in various phytochemical components important in the daily diet. As a spiky orange oddity crammed with green jelly and white seeds, the horned melon has become a global fruit in recent decades. Due to this fruit's remarkable ease of expansion, horned melon could represent an economically advantageous nutritional source to alleviate malnutrition or provide phytochemicals to the food and pharmaceutical industries. In addition to consumer use, the importance of fruits is reflected in the phytochemical composition of non-edible parts that have low commercial value, but with appropriate technology, they can be used as a renewable source of added-value bioactive compounds. Horned melon represents one of the most promising

species belonging to the Cucurbitaceae family due to its exceptional characteristics. This fruit is available for approximately three and a half months in two seasons, namely early spring and autumn. They are characterized by rapid growth, as well as by the fact that they do not tolerate low temperatures. During growth, they need a large amount of water, so if it is a dry season, irrigation is necessary. This plant tolerates a wide range of soil types with a preference for well-drained sandy or loam soils, thus it can grow in the semievergreen forest, woodland, wooded grassland, grassland, and abandoned cultivated areas as well.

Biological benefits of horned melon

Biological benefits of horned melon result from the presence of bioactive antioxidants which protect the cells and their structures against oxidative damage. Studies on macromolecules (DNA, nucleotides, and proteins) free radical-related damage showed that diets rich in polyphenols, carotenoids, ascorbic acid, tocopherols, and other antioxidants contribute to the inhibition of oxidation processes. The antioxidant potential is strongly correlated with the reduction in the risk of various human diseases, which is not only because of individual antioxidants but also may be the result of their synergy.■

POSTHARVEST CARE OF OKRA

About Author ...

Khushboo Sharma*
Division of Vegetable Science
Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir

Vibhu Pandey
Department of Fruit Science
SVPUAT, Meerut (U.P.)

Okra (*Abelmoschus esculentus*) is a widely produced vegetable with a wide range of edible pod size, shape, and colour. The main states in India where okra is grown include West Bengal, Bihar, Uttar Pradesh, and Andhra Pradesh. It can be easily grown in summer and rainy seasons in throughout India. Its sensitive green fingers are also utilised as canned or dried during the off-season. Okra farming relies on careful handling and packaging, and as soon as possible after harvest, quick chilling of the pods. The cane juice is cleaned using the roots and stems of okra plants for making sugar and jaggery. Iodine, which is required for resistance against throat conditions like goitre, is found abundant in okra fruit. The okra pods must be green, soft, 4–5 ridged, and 6–8 cm in length to be suitable for export.

Measures of harvest maturity

The primary pods of okra are ready for harvest within 2 months and to flower and set fruit over at least 3 months after seeding under normal growing conditions. The most widely used maturity index for harvesting okra is pod length and diameter. Okra pods are harvested when the pods are 7.5 to 12.5 cm long (3 to 5 inches) with immature seeds. The texture should be crisp, moist, and fleshy inside. Over-mature pods are tough, dry, and pithy (hollow) inside. External pod colour is another commonly used index of harvest maturity.

Harvest methods

Okra pods should be cut from the plant with a sharp knife or small length of stem, approximately 1 cm long should remain attached to the pod. Plastic pails or small baskets with a smooth internal lining are ideal harvest containers. A simple field packing station for okra can be constructed from wooden poles and polyethylene sheet. The thatch roof provide shade and the roof overhang keeps out the direct sunlight.

Preparation for market

Cleaning: Cleaning involves the elimination of leaves, debris, stem sections and broken pods. Okra should not be washed, since this would lead to a greater incidence of post-harvest decay. Broken pods should also be discarded.

Grading: Pickers should separate unmarketable, oversized and partially decayed pods or damaged pods from the marketable ones in the field at the time of harvest. Okra is usually graded into the following sizes: -Fancy; pods up to 9 cm (3.5 inches) long-Choice; pods 9 to 11.5 cm (3.5 to 4.5 inches) long-jumbo; pods over 1.5 cm (4.5 inches) long but still tender.

Packaging: Okra is packed in various sized container differing in volume and weight, depending on the market destination. Care should be taken to avoid injury especially along the ribs of tender pods. This leads to unsightly brown and black discolouration. Wooden crates, cardboard boxes, woven palmbaskets, plastic crates, nylon sacks, jute sacks, and polythene bags are some of the most popular packing materials used in most developing countries.

Postharvest diseases: Decay is mostly associated with damaged or a wounded area of the pod is very rapid at high storage temperatures, which usually range between 24°C to 27°C.

Fungal disease:

Gray mold: A common postharvest disease of okra Gray mold, caused by the fungus *Botritis cinerea*. Small discoloured spots on damaged areas of the pod, circular water-soaked lesions covered with a gray mold growth are common symptoms shown at ambient temperature for fungal growth. The pods should be cooled immediately after harvest and held near to 10°C to minimize the development of gray mold. Use of protective pre-harvest fungicide or fixed copper sprays to reduce incidence.

Soft rot: Soft rot, caused by the fungus *Rhizopus stolonifer*, is a frequently observed postharvest decay of okra. High temperature, high humidity, and damaged tissue increase the likelihood of disease development. Symptoms started as small water-soaked lesions in the areas of damaged tissue. The entire pod may become covered with a grayish-white mass of mold, which eventually turns black. Nests of mold and decaying okra pods form within packed cartons. The sanitization of harvest containers and grading surfaces, careful handling to minimize wounding of the pod surface, avoiding picking when the pods are wet and cooling of the harvested okra to 10°C as early as possible after harvest can control Rhizopus soft rot.

Pod rot: During the rainy season, Pod rot occurs frequently caused by the soil-born fungus *Rhizoctonio solani*. Wounding and injury to the pod encourages the development of pod rot. This disease is also spread through infected seed, which should be treated with a fungicide before planting. Pod rot symptoms include the presence of small brown to black spots closely pressed to the pod surface, which eventually cause tissue decay. Careful handling and postharvest cooling, sanitation, will reduce the incidence of this disease.

Sour rot: Okra sour rot, caused by the fungus *Geotrichum candidum*, occurs in moist conditions at high temperatures. Rotting is associated with damaged tissue and the decay is soft watery, but not discoloured. Surface lesions become covered with whitish spores. Sour rot can be minimized by careful harvesting and handling practices, and holding the pods at 10°C.

Bacterial disease:

Bacterial blight: Bacterial blight, caused by *Pseudomonas syingae*, can lead to significant amounts of rotting in okra pods having bacterial blight at the time of harvest. Symptoms include numerous small lesions and reddish-brown spots on the pod surface. The disease can be minimized by cooling the okra immediately after harvest and storing the pods at 10°C (50°F).

Physiological disorders:

Chilling injury: Okra is a tropical-originating plant and different cultivars may differ in their susceptibility to chilling injury (CI). Holding okra for only 3 days at 0 ^{o}C (32oF) followed by return to ambient temperatures will result in obvious pitting and discoloration of the pod. Typical symptoms of CI in okra include pod and seed discolouration, pitting, water-soaked lesions, and decay. Symptoms are particularly noticeable after removal of the pods to warmer temperature such as during marketing.

Ethylene discoloration: Ethylene is commonly produced by fruits and vegetables as they ripen and by fungus and bacteria during postharvest decay. Ethylene accentuates okra senescence and shortens the market life of the pods. It causes a fading at high concentrations, the pods become yellow. This can be accomplished by good ventilation in the storage environment and not keeping okra in the same location as of the ripening fruit. 1-MCP, an inhibitor of ethylene perception, is thought to interact with ethylene receptors and thereby prevents ethylene-dependent responses. In addition, decaying okra pods should be removed from the storage area.

Postharvest handling procedures and treatments (1-methylcyclopropene (1-MCP)/modified atmospheric packaging (MAP), calcium chloride ($CaCl_2$) application, edible coating and sanitizing chemicals) will affect the quality and shelf life of the fruits. Failure to follow these best practices has led to significant losses, particularly in developing nations. A result, postharvest losses in okra will continue to be a big concern for its handlers. It is suggested that the government, NGOs, and private groups focus on educating local farmers about simple postharvest measures.

■■■

INTEGRATED PEST MANAGEMENT

OF APHIDS AND TERMITES IN WHEAT

About Author ...

Chandra Kant*
Anam Khan
Ph.D. Research Scholar
Deptt. of Entomology
SVPUA&T, Meerut (U.P.)

Wheat is the most common *Rabi* season cereal crop, and wheat and rice are the India's staple foods. Utter Pradesh, Punjab, and Haryana are the major states involved in wheat cultivation. They contribute major share of wheat production. Punjab is called 'wheat granary' because they have very high productivity. The major wheat grain producing states are Madhya Pradesh, Bihar, Rajasthan, Gujarat, northern part of Karnataka and Maharashtra etc.

Integrated pest management means the combination of all suitable methods and tactics to minimize the uses of chemical insecticides and keep the pest population below the economic threshold level. In India, only a few insect-pests are attacking on wheat crop. Some major insect-pests of wheat are wheat aphid, termite and cut worm.

1. **Wheat aphid-** Wheat aphid is greenish in color. Adult and nymphal stage attack on younger leaves and ears and suck the plant sap. Aphids have piercing-sucking type mouthparts which look like a small tube arising from under the head.

Cultural control

- Regularly monitor pest an defender population.
- Grow 4 rows of maize, sorgum, bajra around field as guard/barrier crop.

Chemical control

Spray Quinalphos 25% EC @ 400 ml in 200-400 L of water/acre or Thiamethoxam 25% WG @ 20 g in 200 L of water/acre.

Biological control

Some bioagents play key role in aphid management like- parasitic wasps, several species of lady beetles and green lacewings.

2. **Termite-** Termites that were previously known to be serious pests of rainfed crop are now adays commonly infesting irrigated wheat also. Termite attack on the wheat at 20-25 days after germination and at ear head stage also. Termite feed on roots and underground portion of stem and finally plants die.

Cultural control

Early sowing should be done. Sowing should be completed till 15 to 30 November. The root aphids and shoot fly attack more on late sown crop.

Preventive measures

Practice crop rotation to reduce the build-up of termites, especially with legume crops. Don't use raw cow dung in the field, the termite gets attracted toward cow dung. There is an increased risk of termite breeding in raw dung.

Use of essential oils as botanicals

There are some essential oils are use as insecticide *i.e.* Mint (*Mentha arvensis*), Ajwain (*Carum capticum*), Lemongross (*Cymbopogon citratus*), Clove (*Eugenia caryophyllata*). The concentration of the essential oil is @ 10% that are capable to kill the 100% of termite population.

Microbial control

Before sowing mix 1 kg of *Beauveria bassiana* per acre of land evenly. *Metarhizium anisopliae is* used as a successful bioagent for termite control @ 1kg/acre. *Bacillus thuringiensis var. kurstaki* is used against termites @ 0.5 kg/acre.

Chemical control

Before sowing, seeds are treated with fipronil 5% SC @ 6 ml or chlorpyriphos 20EC @ 4 ml per kg seed. If termite infestation is seen in standing crop, spray 1Litre of Chlorpyriphos 20% EC per acre of land.

Conclusion

Integrated pest management is the combination of all the methods involved in management of insect-pest in all crops in an effective way and thus reduces the dependence of farmers on chemical insecticides. By the integration of all the pest control methods, the insect-pests can be effectively controlled and managed in wheat crop.

ENTOMOTOURISM

A NEW PERSPECTIVE TOWARDS INSECT CONSERVATION

About Author

R. Pungavi*
S. Aarthi
Ph.D. Scholar
Deptt. of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram (T.N.)

Apocalypse of insects The term "insect" refers to a "six-legged creature," but "apocalypse" refers to a "event resulting in abrupt decline or devastation on a castrotrophic scale owing to Anthropocene." Since decades, scientific research have revealed a massive and severe reduction in insect populations as the sixth mass extinction begins. Insect decrease is a severe problem because of its impact on abundance, variety, and the extinction of entire species. A decline in population involves not only a fall in insect numbers, but also a reduced geographic distribution, which leads to the first step toward extinction. Insects serve a critical part in maintaining environmental equilibrium. They are critical to the survival of the ecosystem. They cycle nutrients, pollinate plants, spread seeds, maintain soil structure, enhance fertility, manage the population of other species, and serve as a primary food source in the food chain. Approximately 87% of all plant species require animal pollination, the majority of which is provided by insects. By burying and digesting dung, certain beetles increase nitrogen cycling and soil structure. People often dislike insects, believing them to be dangerous, toxic, or disease carriers. As a result, using insects in ecotourism activities can be viewed as a potential technique for boosting public awareness about insect conservation.

Entomotourism

Tourism is regarded as one of the most important economic drivers in any country. Wildlife or nature tourism, being one of the key tourism goods, significantly contributes to a country's economic prosperity. Entomotourism refers to the use of insects for wildlife tourism. Entomotourism is a multibillion-dollar sector that employs thousands of people and draws millions of visitors from around the world, yet it is largely untapped. Visitors come from all over the world to see fireflies, while others visit butterfly sanctuaries in Mexico, South Africa, and Taiwan. Nakamura's Dragonfly Kingdom.

Entomotourism spots

1. **Monarch butterfly tourism-** Butterflies are insects that elicit favourable emotions in most people. Monarch butterflies are well-known in North America for their spectacular spring and fall migrations. Monarch Butterfly Biosphere Reserve in Mexico and Michoacán. The oyamel-pine-oak woodland in this legally protected region "serves as the winter habitat for hundreds of millions of monarch butterflies."
2. **Butterfly pavilions-** In 1897, the London Zoo hosted the first public exhibition of butterflies and other insects in Europe. Over 116 butterfly pavilions might be found globally by the twenty-first century. These exhibits are usually quite popular because to the general appeal of butterflies. Montreal, the "Butterflies Go Free" show, which runs during the winter months, has occurred 19 times and drew over 150,000 visitors in 2018. Butterflies and certain types of moths are allowed to fly freely and interact with guests in huge, open

areas in these pavilions. While some butterfly pavilions are permanent and serve as stand-alone tourist attractions, others are temporary. The Cambridge Butterfly Conservatory's "Hug-a-Bug" programme is an example of a common teaching and outreach strategy for butterfly pavilions.

3. **Firefly tourism-** Fireflies, also known as lightning bugs and glow worms, are a species of winged beetle of the Lampyridae family. The estimated 2,000 lampyrid species found in temperate and tropical climes are most recognised for the biochemical light they release to lure mates or prey. In Mexico, only a few tourists took part in the first planned firefly expedition, but 91,000 people had the opportunity to see fireflies in 2016. As a result of the rising demand, over 25 firefly sanctuaries (some state-sanctioned, others not) have been built in the states of Puebla, México, and Michoacán, including the state-designated Santa Clara firefly sanctuary. On 2022, a new species of synchronous firefly was discovered in Tamil Nadu's Anamalai Tiger Reserve, where several lakhs of fireflies had turned ablaze.

4. **Apitourism-** Api-tourism is a sort of entomotourism that brings together beekeepers and travellers eager to learn more about this occupation. Visitors may get the chance to see how beekeepers and bees interact, see the value of pollination, sample several kinds of honey, and "learn about other bee products (pollen, wax, bee bread, royal jelly)". In some cases, they also study apitherapy (the medicinal use of honey bee products). Meli-tourism is another type of bee-related tourism in which travellers engage with melipona (stingless) Mexico is developing a honeybee tourist industry, offering everything from spa services to the use of melipona honey in some dishes, beverages, and health, beauty, and pharmaceutical items.
5. **Dragonfly sanctuaries-** Numerous 'dragon hunters' travel from all over the world to visit dragonfly sanctuaries like the Dragonfly Kingdom at Nakamura, the first dragonfly nature preserve and museum in the world, and the dragonfly awareness trails at the KwaZulu-Natal National Botanical Garden in Pietermaritzburg, South Africa.

Restoration strategy

Include entomotoursim in the conservation strategy and educate the public about the diversity and protection of insects through campaigns, seminars, and conferences. People need to be educated to share the advantages of insects and their conservation aspect rather than memes on social media. Building an insect hotel, butterfly garden, pavilions, bee hotel etc. or taking part in citizen science initiatives on insects are a few of the effective ways to alter behaviour in the entomotourism sector while having a beneficial influence.

■■■

EFFECTS ON THE ENVIRONMENT
DUE TO BURNING OF CROP RESIDUES

About Author ...

Ravi Bhushan Rawat*
M.Tech. Scholar
Deptt. of Farm Machinery and Power Engineering.
SHUATS, Prayagraj (U.P.)

After harvesting a large part of it remains unusable as residue which a source of renewable energy. The quantity of such crop residue in India is about 62 million tonnes. Half its is used for roofing of houses and houses and huts, animals, food, fuel packing and the remaining half is burnt in the fields itself It is estimated that burning of crop residues such as dry wood leaves, and weeds produces 40 percent CO_2, 32 percent CO particulate matter 2.5 and 50 percent hydrocarbons in the atmosphere .The process of burning crop residues the fields pollutes the environment. Soil erosion increases and respiratory residue into the soil is simple. but it also has some difficulties. Like reducing the gap between two crops It also involves additional less irrigation and other activities, which increases the cost of burning stubble. Increasing pollution. According to the study, mixing paddy straw in the soil releases methane gas, which increases global warming. Diseases increases.

By removing these difficulties through a simple simple process, the ill-effect of burning crop residue can be reduced. Therefore, renewal of crop residues is very important for a healthy environment and form an economic point of view.

Chemical diavasin

Due to the resudule of pesticides in crop residues, the toxic chemical disvasin dissolves in the air. By burning The residue at the time of harvesting and after harvesting. The amount of toxic diavasin in the increases by 33- 270 times. The effect of diavasin remains in the environment for a long time, which gets deposited on the skin of humans and animals, and it causes dangerous diseases.

Options and diagnostics

- The government should implement rules for not burning crop residues so that pollution can reduced.
- Biofuels can also be prepared from these residues.
- Soil health can be increased by re-plowing the crop residue in the field.
- The residue can be collected and used for fuel, compost, animal feed, house roof and mushroom production etc.
- A simple solution is to decompose these residues by micro- organisms, which can increases both the physical structure and fertility of the soil by preparing fertile compost.

Concern for clean environment

- Burning crop residues releases hazardous chemicals into the atmosphere, which is a carcinogenic pollutant.
- Is not in our control.
- This air pollution collects on the lower surface of the atmosphere, which has a direct effect effect on the population.
- This type of pollution is spread by the wind in far-flung areas and wide areas, whose contro
- This type of pollution causes global climate change by producing greenhouse gas.

Health problems due to burning of crop residues

- Reproductive diseases increase in women.
- This pollution reduces the level of the testosterone hormone in men.
- Immunity decreases.
- Change in thyroid hormone level.

■■■

TRADITIONAL AGRICULTURAL SYSTEM
OF ASSAM AND THEIR PROTECTION

About Author ...

Dr. Ashoke Kumar Das *
Assistant Professor
Dept. of Botany, Abhayapuri College

Dr. Padumi Singha
Department of English
Bongaigaon College

The traditional agricultural system is an integral part of the Assamese culture. But the modernization of agriculture has now threatened the whole traditional system and thus made it a vulnerable one. The age-old interrelationship between the local communities and their rich cultures are now on the verge of extinction. Evolution of society and culture is inevitable for every human society around the world. But the motif and change within a short span of time has reduced its acceptability. The overexploitation for more production and profit are the cause of ecological imbalance. Extensive use of machines, chemical fertilizers and pesticides poses the threat to agricultural sustainability. The agriculture based rural economy of Assam has also been deteriorated in an alarming way. Once, there was no record of farmer suicides particularly in this part of the country, but now it has been increasing. The government policies are also responsible for the decrease in profit from agricultural produce due to increasing cost of production and also the cut on subsidy. For these reasons, a huge number of tribal and local farmers are leaving their age-old traditional agricultural practices. Landless farmers who were engaged in agriculture through lease from other farmers or landlords are now completely left out from the system. At present, in some parts of Assam, a section of hardworking Muslim labour class people are seen to engage in some modern techniques of agriculture for gaining more profit. Some of them are completely unaware of sustainable agriculture practices applying excessive chemical fertilizer, pesticides etc. This unsustainable mode of agricultural

system will definitely create imbalance in the natural ecosystem.

There is direct link between the biodiversity and culture. In traditional agricultural system of Assam, a large number of crop varieties are grown, which itself is a process of conservation of genetic diversity, which is now under threat. The Green revolution of India began with the slogan of the significance of high yielding verities and their productivity but it fails to create awareness about the question of biodiversity loss. Most of the traditional crop verities are now become locally extinct around the state. Only a few rice verities are now cultivated, but within a few years these verities will also be vanished from the field. Another threat from monoculture is the result of decreasing profit of traditional multicultural system. After tea and rubber, the newly introduced species is now the palm oil. Palm oil plantation has already been started in several places of Assam.

In 2002, the Food and Agricultural Organization (FAO) of United Nations has started an initiative to conserve the Globally Important Agricultural Heritage System (GIAHS). According to FAO, the goal is to identify and safeguard Globally Important Agricultural Heritage Systems and their associated landscapes, agricultural biodiversity and knowledge systems through catalyzing and establishing a long-term programme to support such systems and enhance global, national and local benefits derived through their dynamic conservation, sustainable management and enhanced viability. Under this concept, there are two such GIAHS in India, one is Koraput Traditional Agriculture in Koraput region of Orissa (2012) and the other is Kuttanad Below Sea Level Farming System in Kuttanad region of Kerala (2013). Unfortunately, the entire Northeastern states have not found a position in the GIAHS list.

Anurudh K. Singh and Rai S. Rana, both were former Director of National Bureau of Plant Genetic Resources has recognized a total 48 different agricultural systems in India which have potential for their global recognition under the FAO Initiative of GIAHS. Among which two are from Assam, one is the Rice-fish cultivation in rain-fed lowland of the Brahmaputra Valley and the other is the Sericulture system in which rearing of silkworm species – *Antheraea assamensis* (Muga silk) and *Philosamia rinini* (Eri silk) are done exploiting local host plants in the hills of Assam.

According to Convention on Biological diversity, agricultural biodiversity has high importance in social-cultural, economic, and environmental aspects. It provides not only food and income but also raw materials for clothing, shelter, medicines, new breeding varieties, and performs other services such as maintenance of soil fertility and biota, as well as soil and water conservation, all of which are essential to human survival. The government agencies, especially the department of agriculture can extend their proactive role to recognize and protect the traditional agricultural systems of Assam.

■■■

USE AGRICULTURAL EQUIPMENT 'MULCHER' IN THE FIELD TO INCREASE THE FERTILITY OF THE SOIL

About Author ...

Naveendra Kumar Patel*
Ph.D. Scholar
Deptt of Farm Machinery & Power Engineering, SHUATS, Prayagraj (U.P.)

Rahul Kumar Yadav
Ph.D. Scholar
Deptt of Farm Machinery & Power Engineering, GBPUAT, Pantnagar (UK)

Vipin Mishra
Ph.D. Scholar
Deptt of Irrigation and Drainage Engineering, SHUATS, Prayagraj (U.P.)

Mulcher has an important place in agricultural machinery. The mulcher is operated in the fields by attaching it to a tractor. Mulcher is very helpful in cutting straw and stalks after harvesting. Mulcher works in a very simple way in cutting gardens, paddy, mulching grass and shrubs. The biggest feature of this equipment is that this equipment helps in maintaining the fertility of the soil. Along with this, less water and fertilizers are used for sowing the next crop. Let us know the special things related to mulcher.

Know how mulcher works

Agricultural equipment mulcher is specially designed for the management of crop residues. It works great with 45 to 90 HP. It mulches at 1800 rpm. When it is attached to the tractor, it gives easy and much better coverage. Mulcher machine performs three operations at a time like cutting, chopping, mixing with soil.

Features of mulcher

- ✓ The mulcher is operated by connecting it to the tractor. For this, there should be a tractor of more than 45 horsepower capacity.

leaves with the soil. This helps in retaining moisture in the soil for a long time and the next crop requires less irrigation.

- ✓ It flattens the weed along with the root and makes it into dust.

- ✓ Mulcher is a special type of shearing machine which is operated by trailing tractor with double clutch of 50 horse power.
- ✓ Mulcher helps a lot in finely chopping the crop residues.
- ✓ Mulcher is very helpful in cutting straw and stalks.
- ✓ Mulcher is used for cutting green fodder, cutting banana crop, cutting vegetable residues into small pieces, besides cutting tall grass and small bushes.
- ✓ Mulcher mixes wheat and paddy straw, sugarcane leaves into fine pieces and mixes them in the soil of the field, which increases the fertility of the field and less fertilizer has to be given in the next crop.
- ✓ After sugarcane harvesting, when mulcher is run on the leaves lying in the field, the mulcher mixes the
- ✓ By using mulcher, crop residues are mixed in the soil of the field, which saves from burning residues and gives relief from environmental pollution.
- ✓ Mulcher is a boon in case of stubble burning. This machine mixes the old in the ground itself. Which becomes manure in 15 to 20 days.

Benefits of mulcher

- ✓ Its use is a better option than burning crop residues, burning crop residues not only harms the environment but also damages agricultural land.
- ✓ Mulcher cuts and mixes the residues in the soil, which increases soil fertility and the residues of the previous crop act as organic fertilizers for the coming crops.
- ✓ It is a useful tool for harvesting sugarcane, as well as it is the most efficient agricultural tool for cutting many crop plants from the soil surface.

Difference between rotavator and mulcher

Many farmers are unable to differentiate between rotavator and mulcher. To them both the machines appear to be the same. Tractor Junction tells you what is the difference between rotavator and mulcher.

- ✓ Both rotavator and mulcher run attached to the PTO of the tractor.
- ✓ Must have a tractor of more than 45 HP to operate both the implements.
- ✓ Rotavator loosens the soil while digging the soil while mulcher cuts the crop residue.
- ✓ Rotavator has iron blades. Blades come in J, L and C types.
- ✓ L type blade is most prevalent in India.
- ✓ With the help of rotavator blade digs the field up to six inches and pulverizes the soil, it makes the soil friable.
- ✓ Mulcher always pulverizes the crop residue. It consists of a rotating drum. In which there are trishul type blades. The rear side cutter blade is used to break the crop residue into small pieces.
- ✓ Mulcher is the best tool if wheat is to be sown by managing the stubble.

■■■

ORGANIC AQUACULTURE

Devarshi Ranjan*
MFSc.
Department of Aquaculture College of Fisheries, Dholi, RPCAU, Pusa, Bihar
Priyanka Verma
MFSc.
Deptt. of Fisheries Resource Management, College of Fisheries, Dholi, RPCAU, Pusa, Bihar
Mayank Bhushan Singh
MFSc.
Deptt. of Aquaculture, ANDUAT Kumarganj Ayodhya

Due to unsustainable fishing methods, widespread aquatic pollution, commercial exploitation of aquatic environments, and destruction of primary breeding environments including mangrove forests and coral reefs, fisheries in the world are under threat. Today, aquaculture practices have become more intensive globally, due to which excessive amounts of antibiotics, PCBs, pesticide residues and heavy metals are being used in aquaculture, which has seriously damaged the ecosystem. Therefore, to prevent all these effects, nowadays organic aquaculture is being practiced. Through this practice, farmers are producing good quality and high value fishes, by doing this they save both the environment and humans.

What is organic aquaculture?

Organic aquaculture is the production of quality food by managing all-natural and environmental resources in a stable aquatic environment, without using any chemicals, as well as securing genetic resources and the richness of species in a native system.

Farmed organic fishery products

Name of aquatic animals	Country
Black tiger shrimp	India, Vietnam, Bangladesh
Vennami shrimp	Ecuador, Peru
Freshwater shrimp	USA,Bangladesh
Tilapia	China, Israel, Brazil, Honduras
Pangasius catfish	Vietnam
Carps	Eastand Southern Europe
Trout and sea bream	Eastern, Western and Southern Europe: Europe
Cod	Norway
Atlantic salmon	U.K., Ireland, Chile
Mussels	New Zealand

Organic aquaculture in India:

The Central Government of India established a National Institute for Organic Farming in Madhya Pradesh in October 2003. Whose work was to make rules and regulations, as well as to certify the product according to international standards. On 1 November 2007, the world's first organic aquaculture harvest of giant freshwater prawns, or scampi, was made in the backwaters of Kerala. This unique project was implemented in collaboration with the State Secretariat of Economic Affairs {SECO}, Switzerland with the help of Marine Products Export Development Authority {MPEDA} of India. The Indian project for organic black tiger and scampi was launched to capitalize on the enormous market opportunity for aquaculture products in European markets. Organic aquaculture project in India started in January 2007 in the coastal state Andhra Pradesh and Kerala with technical consultation from MI BlueU. Certification is required for selling organic products internationally. For this, Natureland of Germany was selected as the certification agency, while Indocert of Kerala was selected for inspection.

India is one of the richest countries in terms of shrimp and fish production in the world and if organic aquaculture is done here, it can fulfill the demand of organic aqua products in European and American countries. All of the major supermarket chains, including Coop in Switzerland, Aimare in Austria, and Bristall Bay in the United States, are looking for organic food suppliers everywhere.

Principles:

Aquaculture that is organic is based on a few principles:

- Avoid using chemical fertilizers and feed additives
- Leaving green manure crops and their residues in the pond
- Prohibiting the Use of Genetically Modified Organisms
- Using only natural things such as use of dung and urine of cattle, use of compost, and use of farm made feed etc.

Fig. 1. Principles and effects of organic aquaculture

Importance of organic aquaculture:

- Organic aquaculture protects human health
- Organic aquaculture changes the soil structure and protects beneficial micro-organisms that live in it.
- They also help in regulating the amount of fish meal and protein used in the feed.
- Inorganic fertilizers are not used: In this, instead of excessive input, only nutrients are recycled.
- Synthetic pesticides and herbicides are not used
- Help in reducing input through restriction on energy consumption (e.g. regarding aeration)
- In organic aquaculture only natural ingredients are used rather than antibiotics and chemotherapeutics
- Organic aquaculture is environment friendly
- The final products of organic aquaculture are very good for the health of humans and other animals because it's processing has done under organic principles and protocols.

Conclusion:

In organic aquaculture system aquatic items could be raised sustainably and without contamination. In this system only organic feed are used without any application of feed additives or medicines to improve animal health. In traditional organic farming, farmers used only organic fertilizers to grow crops; along with this he used only locally available ingredients instead of probiotics and other chemicals in livestock production. But with the increasing population, at present, inorganic fertilizers and other chemicals are being used a lot, which is harming the health of humans and other animals. Therefore, to get rid of these problems, we have to once again come towards organic farming. The government and some organizations are also working continuously to promote organic farming. Sustainability, environmental stewardship, comprehensive, and integrated industrial processes are characteristics of organic systems. Therefore, keeping health and environment in mind, we need to leave modern farming and return to traditional farming to maintain the chain of organic products from farmer to consumer. This work will not be done by one day or one mission, for this we all have to start organic farming only then we and our family and our motherland will be happy.

NEED TO FOCUS ON INCREASING AGROFORESTRY

About Author ...

Rashav Chahal*
Research Scholar
ANDUAT, Kumarganj,
Ayodhya (U.P.)

Climate change is highly likely to have negative consequences for agriculture all over the world. Extreme weather events which are consequences of climate change are likely to reduce overall productivity of agriculture. Flash floods, droughts, untimely rains, hailstorms, heat waves and cold waves bringing temperature unsuitable for crops will demand adaptation of agriculture practices to new climatic conditions. In this context Agro-forestry is important for India as well as other developing countries.

Agroforestry

Agroforestry is defined as a land use system which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. It is a dynamic, ecologically based, natural resource management system that, through integration of woody perennials on farms and in the agricultural landscape, diversifies and sustains production and builds social institutions.

Significant of agroforestry

Economic value:

It meets almost half of the country's fuelwood needs, about two-thirds of the small timber demand, 70-80% of the plywood requirement, 60% of the raw material for the paper pulp industry, and 9-11% of the green fodder needs.

Carbon sequestration:

Agroforestry or tree-based farming is an established nature-based activity that can aid carbon-neutral growth.

Lower consumption of fertilisers:

Nitrogen fixing trees grown in the agroforestry systems are capable of fixing about 50 -100 Kg Nitrogen/ha per year - one of the most promising components of the agroforestry system.

Ecology friendly:

Use of lesser chemicals will also help in mitigating anthropogenic effects on climate.

Global climate goals:

Agroforestry can also help India meet its international obligations on -

- **Climate-** creating an additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide equivalent through additional forest and tree cover by 2030 and net-zero by 2070.
- **Desertification -** achieving 26 million hectares of Land Degradation Neutrality by 2030, thus, meeting 9 of the 17 Sustainable Development Goals.

Better agriculture yields:

Higher yields of crops have been observed in forest-influenced soils than in ordinary soils.

Issues in adopting agroforestry

Lack of information among farmers:

Although agroforestry is not unknown in India, many farmers are not keen to take it up because of a lack of information on tree rotation and also the legal aspects involved in the trade of matured trees.

Financial constraints:

Inadequate investment in the sector is also a cause for neglect. Unlike the credit and insurance products available for the crop sector, the provisions for growing trees-on-farms are minimal.

- Weak marketing infrastructure, absence of price discovery mechanisms and lack of post-harvest processing technologies further compound the situation.

Small and marginal fields:

Most of the farmers are small and marginal having small fields (less than 2 ha). In this area it is economically and spatially agro-forestry is unviable.

Promotion of agroforestry

- The sector needs to be institutionally bolstered and profiled from the perspective of its utility spectrum that knits farm-forestry, environmental protection, and sustainable development.
- Financial support should be provided to all small landholders, rather than only Scheduled Caste and Scheduled Tribe farmers.
  - Protocols need to be developed where smallholders can earn income through carbon trading.
  - Institutional credit with longer funding cycles, a moratorium on interests, and insurance products suitable for agroforestry must also be designed.
  - The private sector too should invest in agro-forestry both as a commercial enterprise as well as through the route of Corporate Social Responsibility.
- Farmer collectives-cooperatives, self-help groups, Farmer -Producer Organisations (FPOs)- must be promoted for building capacities to foster the expansion of tree-based farming and value chain development.
- The current situation of agroforestry calls for amending unfavourable legislation and simplifying regulations related to forestry and agriculture.
- Policymakers should incorporate agroforestry in all policies relating to land use and natural resource management, and encourage government investments in agroforestry-related infrastructure and in the establishment of sustainable enterprises.
- Scientists and researchers can develop location-specific tree-based technologies that complement the crop and livestock systems for sustainable livelihoods, factor in gender concerns, and incorporate the feedback from local communities.

Conclusion

Trees play a great role in reducing the ill-effects of climate change, promoting timber industry, controlling soil erosion, reclaiming land, conservation of biodiversity and doubling the income of farmers through carbon sequestration and carbon financing besides beautification of the sites and other environmentally-significant roles.

MUSTARD BREEDING FOR ALTERNARIA BLIGHT RESISTANT

About Author ...

Ujjwal Yadav
Apex University, Jaipur

In India, rapeseed-mustard *(Brassica species*) are placed at second position in total acreage (23.91 per cent) and production (27.19 per cent) after soybean among oilseeds crops. Breeding system for a crop species mainly depends upon it's mode of pollination. Here, we will emphasize primarily on the breeding of Indian mustard *(Brassica juncea)* for Alternaria Blight *(Alternaria brassicae)* disease resistance.

Breeding objectives

Alternaria blight *(Alternaria brassicae)* disease has been reported from all the continents of the world and is one of the important diseases of Indian mustard causing up to 47 per cent yield losses. In India, three distinct isolates of *A. brassicae* namely A (highly virulent), C (moderately virulent) and D (avirulent) has been reported. In Indian mustard, no proven source of resistance against *Alternaria* blight reported yet, but some sources of tolerance against this disease have been identified. Moreover, some resistance sources have been identified in related and wild species of *Brassica* like *Sinapis alba* L., *Camelina sativa, Capsella bursa-pastoris, Neslia paniculata* and taramira, *Doplotaxis berthautii*, D. *catholica*, D. *cretacea*, D. *erucoides* and *Erucastrum gallicum*. Inheritance studies suggested that tolerance to *Alternaria* blight is governed by multigenes or cluster of genes with additive or partial dominance effects.

Resistant against *Alternaria*

Host resistance against *Alternaria* species has various components and it is multilayered. Inheritance of resistance in inter and intra-specific crosses of *B. juncea* and *B. carinata* to *A. brassicae* is governed by additive genes, dominant genes, additive × additive type epistatic genes, additive × dominance and dominance × dominance type of non-allelic interaction genes. Inter-mating between tolerant plants helps in increasing the level of resistance against *A. brassicae* by pyramiding of resistant genes. High level of horizontal resistance in genotypes of oilseed *Brassicas* has been recorded. Genotypes PR-8988, PR-9024, PAB-9511, PAB-9534, EC-399296, EC-399299, and PHR-2 show higher degree of tolerance/ partial resistance or slow blighting. Epicuticular wax (Candle, Tobin, and Tower), low number and narrow stomatal aperture (Tower, RC-781) provide resistance to *Alternaria* infection in *Brassica* species. The concentration of phenolic compounds, activation of polyphenol oxidase and catalase is higher in tolerant genotypes. Chitinase modifying proteins (cmps) are secreted by fungal pathogens of crucifers, which interfere with fungalysin cmp activity to improve plant resistance against multiple fungal diseases. GLIPl in association with ethylene signaling may be a critical component in plant resistance *(A. thaliana)* to *A. brassicicola*. *B. juncea* plants transformed with chitinase gene tagged with an over expressing promoters, 35S CaMV give defense response by degrading the cell walls of invading fungi. -aminobutyric acid treatment leads to proper balance of oxidant and antioxidants suitable for expression of resistance in *B. carinata* against *A. brassicae* by curtailing pathogens entrance during early stages of colonization. Zeatin a cytokinin up regulates plant immunity via an elevation of MAPK-4 and antagonizes the effects of *A. brassicae*.

Breeding approaches for resistance

1. Genetic engineering

Non-availability of resistance sources within cross able germplasm of Brassica needs the use of genetic engineering approaches to develop genetic resistance against Alternaria blight. A number of genes for imparting resistance this fungus has been

transferred to *B. juncea* via genetic transformation technique. *Osmotin* protein introgressed into Indian mustard delayed the appearance of symptoms of Alternaria blight disease. Class I basic *glucanase* gene from tomato have been transformed into *B. juncea* v ar. RLM 198 and found that the transgenic plants expressing *glucanase* exhibited restricted number, size and spread of lesions caused by *A. brassicae* under pathogen-challenged conditions and the onset of disease was also delayed as compared to the non-transformed plants. reported a significant inhibition in hyphal growth of both A. *brassicae* and *Sclerotinia sclerotiorum* in transgenic Indian mustard plants developed with *msrAI* gene coding for antimicrobial peptides, potential for resistance against a broad spectrum of phytopathogens. developed transgenic *B. juncea* cv. Varuna plants with *thaumatin* gene *through Agrobacterium tumefaciens-mediated* genetic transformation technique. T_1 transgenic lines expressing the *thaumatin* gene showed an enhanced resistance against *Alternaria brassicae* by inhibiting the fungal growth up to 54 per cent as compared non-transformed plants.

2. Screening techniques

Various screening techniques have been used by various workers for particular disease. However standard methods adopted in All India Coordinated Research Project (rapeseed and mustard) for screening of resistant/ tolerant genotypes against white rust, Alternaria blight, Sclerotinia stem rot and downey mildew is detaled below: (Proceedings, 24th AGM of AICRP-RM, ICAR-DRMR Bharatpur).

Method of artificial inoculation for *Alternaria* blight

Test plants (including checks) should be inoculated twice i.e. at initiation of flowering and pod formation in the afternoon (after 1500 hrs) with conidial suspension (105 du/ ml) of pure culture of *Alternaria brassicae* using distilled water. Disease severity should be recorded 90 DAS/at maximum disease pressure on leaves and 15 days before harvest on pods.

INNOVATIVE APPROACHES OF CROP IMPROVEMENT

About Author ...

Surendra Kumar*
Aranav Yadav
Anuj Mishra
Deptt. of GPB

CSAUAT, Kanpur (U.P.)

Plant breeding plays a significantly important role in ensuring global food security. The human population is expected to reach 10 billion by 2050 (FAO, 2017). Learning how to successfully feed the growing population is a significant task of our day. The Green Revolution and improvements in plant breeding techniques are primarily to thank for the current crop yields, which can feed the majority of the world's population. However, due to both climate change and the scarcity of arable land, food output appears to be plateauing and even dropping; to feed a world population of 10 billion people, production yields would need to be increased by 60%. Mutation breeding, one of many plant breeding techniques, has demonstrated exceptional effectiveness in crop development at a far faster rate than traditional breeding. Plant mutation breeding is neither an innovative subject nor a cutting-edge method. Precision breeding techniques are emerging as the next-generation of plant breeding, and genome editing techniques have been created to introduce precise and predictable genome modifications into plants to get desired phenotypes (Fig.-1). One of the most sophisticated technologies for editing crop genomes is CRISPR-Cas (clustered regularly interspaced short palindromic repeats). Plant breeding aims to produce and take use of these genetic differences.

Plant genome editing technologies

Utilizing programmable sequence-specific nucleases for plant genome editing (SSNs). SSNs include the CRISPR-Cas system, transcription activator-like effector nucleases (TALENs), zinc-finger nucleases (ZFNs), and engineered homing endonucleases or meganucleases. These nucleases cause DNA double-strand breaks (DSBs) at their intended targets, and DNA repair mechanisms allow for precise genome changes.

General procedure for plant genome editing

The general procedure for genome editing in plants can be divided into six steps:

a) Select the appropriate nuclease based on the target sequence.
b) Construct genome editing vectors.
c) Validate the activity of these vectors using protoplasts (wall-free plant cells released from enzyme-digested tissues; optional step).
d) Deliver genome editing reagents into plant cells.
e) Regenerate genome-edited cells into plantlets via tissue culture.

f) Screen and genotype the resulting Genome-edited plants.

Genetic modifications generated by genome editing in plants

The emergence of the CRISPRCas system has sped up the development of plant genome editing in addition to ZFNs and TALENs. The Cas9 and Cas12a complexes, which are both single effector proteins that carry out nucleic acid cleavage, are the most used CRISPR-Cas systems.

Crop improvement strategies based on genome editing

a) Genome editing directed mutagenesis to break genetic linkages and share traits across species.
b) Homeoalleles and gene family multiplex genome editing.
c) Modifying quantitative trait loci to generate novel alleles and characteristics.
d) Diagrammatic representation of the rapid domestication of wild rice.
e) Endogenous gene genome alteration for the purpose of inducing haploidy and creating artificial apomixis.
f) The use of CRISPR for large-scale screening and directed evolution for trait discovery.
g) Plant synthetic biology using CRISPR, in which plant cell behaviour is changed to promote plant growth and product production.
h) Changing the microbiome of plants to increase crop growth and pest resistance.

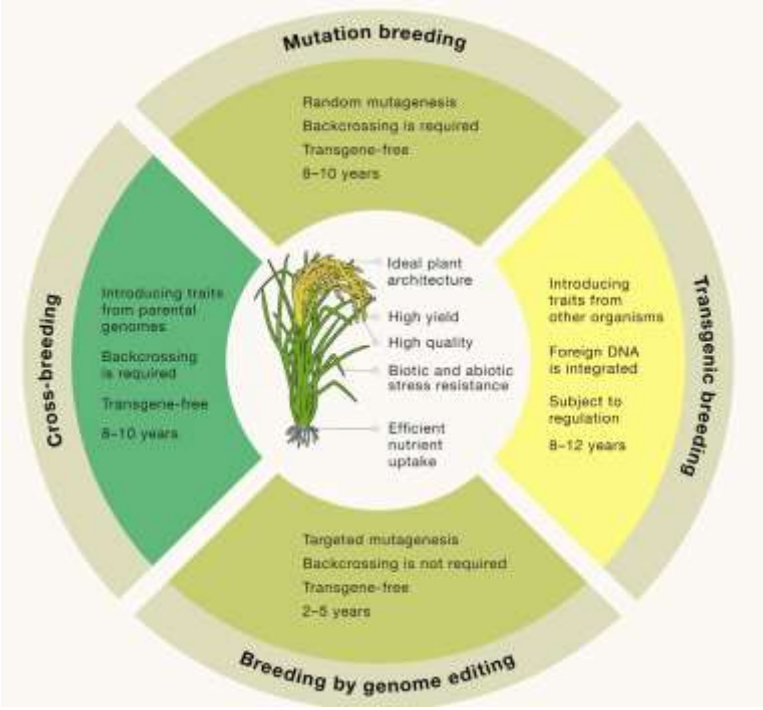


Fig.- 1. Plant breeding techniques commonly used to introduce new traits into an elite crop variety

Challenges and future perspectives increasing precise genome editing efficiency

It is still not possible to produce all required modifications in a genome, despite the most recent technical developments in plant genome editing. Crop trait enhancement urgently requires precise genome editing, such as the creation of targeted nucleotide substitutions, gene insertions/deletions, and gene replacements. In theory, any genome could be accurately rewritten using HDR-mediated genome editing, and a specific edit might be achieved.

Conclusions

A wide range of prospects for plant breeding are made possible by the development of genome editing technology in plants. Genome editing's effective, focused, and targeted mutagenesis has created the groundwork for a number of next-generation breeding techniques that will transform agriculture in the future. All methods must be investigated in order to utilise plant genome editing to its fullest potential. Crops can be intelligently developed with a combination of genetic features thanks to genome editing. When employed for quick plant breeding, these accurate and effective approaches produce results that are comparable to those of traditional breeding.

■■■

DID YOU KNOW?

INTERNATIONAL YEAR OF MILLETS 2023

Grains are classified as Positive, Neutral and Negative. And the Millet range of grains constitute as Positive and Neutral grains.

NEW TECHNOLOGIES FOR PHYSIOLOGICAL

CROP IMPROVE UNDER SYNTHETIC SEEDS

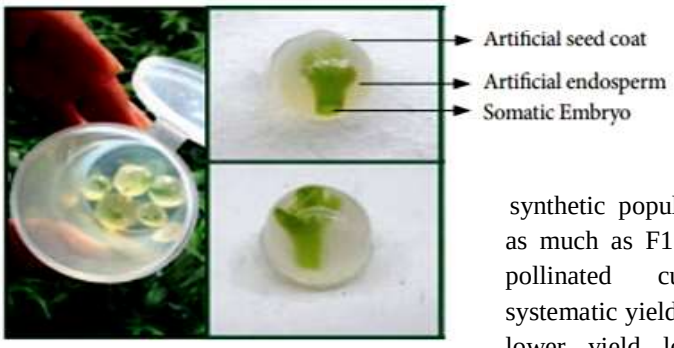
About Author

Dr. Srikanth G.A.*
Assistant Professor
Department of Plant Physiology
SIIASHT, Channapatana, Karnataka

Scientists were expected to meet the era's rapidly growing population's desire for food. Therefore, incorporating synthetic types into agriculture is one way to improve productivity. In a wide range of cross-pollinated species, synthetics and the specialised populations developed from them known synthetic varieties that are entirely identical to synthetic cultivars are frequent by products of plant breeding processes. Through the intercrossing of various genotypes with known superior combining capacity, a synthetic variety is created. It is necessary to have thorough knowledge of the synthetic varieties' selection process, development, application, source, and derived population in order to apply them in breeding techniques. Therefore, the development and use of synthetic cultivars in crop enhancement are reviewed in this work.

Introduction

Open pollinated populations known as synthetic varieties are created through the haphazard mating of particular genotypes. The term "synthetic varieties" was first proposed by Hayes and Garber, who characterised them as cultivated varieties varieties produced by intercrossing selfed plants or lines with high general combining capacity and then preserved by periodic mass selection techniques from isolated plantings. The final commercial cultivars



might be hybrids and open-pollinated populations. The resources, breeding programme stage, infrastructure, labour force for seed production, and socioeconomic considerations all play a role in cultivar selection. The advantage of hybrid cultivars is their potential for increased yields and consistency. They are preferred to populations that are open to pollination and which are more heterogeneous.

A cultivar that is preserved from open-pollinated seed since being synthesised by hybridising a number of carefully chosen genotypes that have all been put through a combining ability test is referred to as a synthetic variety. In the case of maize, bulk selected populations could be the constituents of a synthetic variety. The components are kept in order to be able to reconstitute the synthetic type when needed.

Synthetic varieties improvement

In general, you can create diversity from which to pick using synthetic groups and the composite crossings outlined below, either by bulking or repeated mass selection. In order to generate a synthetic population, synthetics can also be produced as a goal in and of themselves, with the original crossings being grown into a mixture that is recreated annually.

Improved cultivars are synthetic cultivars that are often created by open pollinating polycross seeds of chosen parents for three or four generations. This is a fantastic approach to produce open-pollinatedlines that are diversified new landraces. Although they perform better than conventional open-pollinated types, synthetic populations do not produce as much as F1 varieties. Older open-pollinated cultivars with less systematic yield-focused breeding have lower yield levels than synthetics, which can be achieved. Additionally, they can be passed along through several generations with no loss of production. Synthetics presently produce lower yields, which are probably not suitable for the majority of farmers, according to several research.

Synthetic population through superior inbred lines

In addition to use maize synthetic populations as a source of better inbred lines for hybridization programming, breeders aim to improve them. Any maize population's worth is based on both its inherent potential and its capacity for combining during crosses. For plant breeding efforts to employ genetic resources as effectively as possible, it is crucial to have knowledge about the genetic diversity of species.

Using molecular markers, particularly AFLP For the manufacture of synthetics, amplification fragment sequence polymorphism markers aid in the selection of suitable parents with genetic dissimilarities. The ability of the material to combine is the most important factor to take into account, regardless of the kind of material that will be utilised to build a synthetic population. The advancement of progenies, their testing for combine ability, making all feasible cross variations, predicting the efficiency constituting a variety of experimental synthetic materials, checking their land productivity in yield trials over places, and eventually releasing those that excel

the classic evaluation are all necessary to create synthetic varieties.

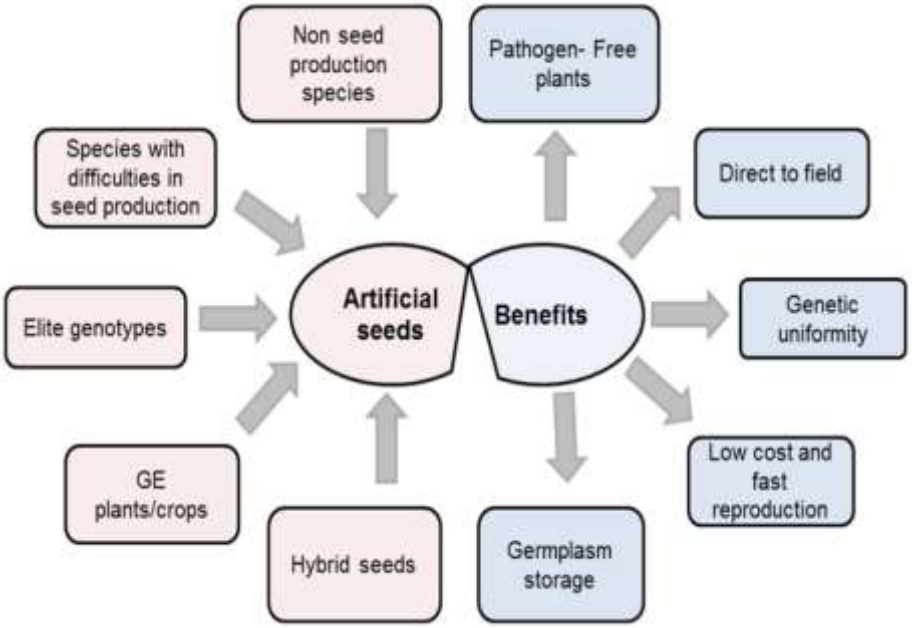
Methods for selecting different genotype

Variety of strategies was used to choose the top performers. The selection techniques for the generation of synthetic varieties are mass selection or phenotypic selection. For research on genetic diversity and marker-assisted selection for the creation of synthetic varieties, biomarkers have been frequently used.

New technologies for seed production

The most efficient and intense way to develop perennial forage plants like alfalfa by polycross is through breeding with synthetic varieties. To choose individual clones for the manufacture of synthetic varieties, traditional breeding experiments take a lengthy period. The selection of genetically distinct potential parents for the creation of synthetics is aided by the use of molecular markers, particularly AFLP (Amplified variable length polymorphism) markers. It has been demonstrated that the primary synthetics are a priceless source of genetic variety for disease resistance. Additionally resistant to leaves blotch, glume black spot, head rot, yellow leaf blight, bacterial leaf, powdery mildew, karnal bunt, and other diseases was synthetic wheat.

Due to self incompatibility and lengthy breeding cycles, the great majority of tropical fruits are propagated through vegetative means. Spread is aided by the utilization of synthetic seed. The preservation of these species' germplasm would benefit the most from artificial seed, though. By boosting the genetic variation of the crop, synthetic varieties can help countries with widely varying climates, like Ethiopia, combat the effects of global warming. Additionally, because it is resistant to numerous illnesses and insects, it can stabilise production and productivity.



Biological components and genomic tools

Synthetic genomics is described as "the intentional layout of artificial biomolecules, rather than on the knowledge of natural biology; it is ascertained on the engineering of genetic components and systems, which do not exist in nature, as well as the re-engineering of established biological elements." The goal of synthetic biology is to create and model new biomolecular networks, components, and processes. These are then used to reprogram and rewire organisms to address a variety of problems.

The creation of functional minimum genomes that will serve as substrates for the metabolic production of compounds with commercial importance is one of the objectives of synthetic genomics. The first commercial uses of this novel method are anticipated to be in the manufacture of biofuels, medicines, and the biotransformation of environmental contamination. A gene that contains the same sequence of amino acids as the plant protein but is optimised for production in the chosen engineered microbe has been created thanks to synthetic biology.

It has been possible to discover and track genetic differences among the different strains using this method's massively parallel throughput, which has shed light on why some strains are superior to others. Developing nations should connect with this technology as the world moves toward it in order to increase their crop improvement skills and feed their populations who are malnourished and in need of food.

Conclusion and future outlook

Scientists nowadays face a dilemma in meeting the population's ever increasing demand. Additionally, the rate of global warming is rising daily. Many farmers in Africa are currently suffering as a result of this. Synthetic variants might play a key role in achieving this. Future breeding will be a good option because different kinds employ this way of development for disease resistance, as a technique of multiplication, and for preserving in genetics for a long time.

■■■

PRE-BREEDING

A VALUABLE APPROACH FOR CROP

S. Divya*
Ph.D. Scholar
Genetics and Plant Breeding
TNAU, Coimbatore (T.N.)
K. Geetha
Professor
Plant Breeding and Genetics
Regional Research Station
Paiyur, Krishnagiri, TNAU,
Coimbatore (T.N.)

Genetically enhancing the plants for human benefit is the art and science of plant breeding. It is practised by skilled farmers and plant breeders from all over the world. The genetic diversity of crop plants is the cornerstone for the sustained production of novel varieties for challenges that occur from a variety of biotic and abiotic pressures in the present and the future. Pre-breeding is the collective term for all operations intended to isolate desirable features and genes from un adapted materials that cannot be utilised directly in breeding populations and to transfer these qualities to an intermediate group of materials that breeders can use going forward to create new varieties for farmers. The main factor limiting production and productivity globally is the limited genetic diversity of cultivars and the inadequate exploitation of genetic resources. Pre-breeding provides a special chance to take advantage of this genetic diversity by introducing desirable genes from wild germplasm into cultivated backgrounds that may be employed quickly and with the least amount of linkage drag. Pre-breeding aims to restore lost genetic variation, hence give back the genetic diversity of crops. Finding a desirable trait, capturing its genetic diversity, and transforming those genes into usable form comprise the pre breeding process.

Pre breeding strategies:

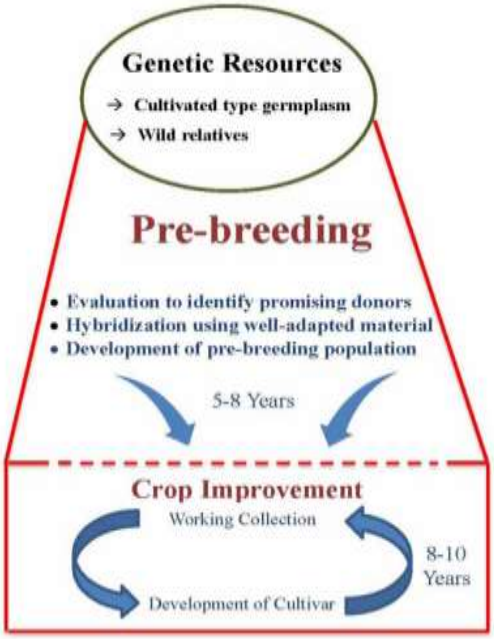
All materials that are accessible for enhancing a cultivated plant species are referred to as plant genetic resources. Gene banks are collections of diverse genetic material from cultivated species as well as their wild relatives and other species. By giving pre-breeders and breeders access to fresh genetic variation that enhances the value of future varieties, gene banks ultimately serve the purpose of ensuring the long-term supply of crop germplasm to support agricultural productivity. Pre-breeding aids in bridging the gap between individuals who integrate novel features into their variety and those who are familiar with the scope of germplasm collections. Plant genetic resources and breeding are connected through pre-breeding. Plant breeders and gene bank administrators need to figure out how to make it simpler to use gene bank material to create new varieties with the features the world needs.

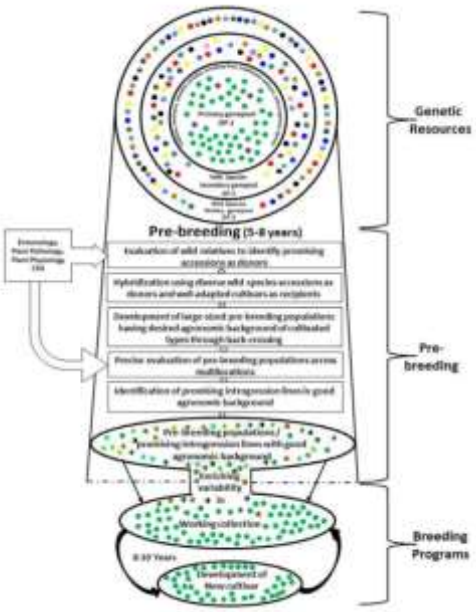
The gene pool concept:

The complete genetic diversity of a species breeding population and closely related species that are capable of interbreeding with it is known as its gene pool. Botanical variations, landraces, inbred lines, antiquated and contemporary cultivars, related wild species, subspecies, and weedy companion plants make up the gene pool of a crop.

Major applications of pre-breeding in crop improvement:

Pre-breeding has four primary applications: Expanding the genetic base





to minimise vulnerability; locating traits in exotic materials and transferring those genes into material that breeders can more easily access; introducing genes from wild species into breeding populations when doing so appears to be the most effective strategy; and locating and transferring novel genes from unrelated species using genetic transformation techniques. By permitting greater access to and use of genetic differences preserved in genebanks, the adoption of pre-breeding increases the efficiency and effectiveness of crop development programmes.

There are four main obstacles to overcome: (i) lack of characterisation and evaluation data; (ii) knowledge of genetic diversity; (iii) relationships across species; and (iv) a strong breeding programme and financial sources. Due to the extreme difficulty and length of time frequently involved in sorting out the useful genes from the unwanted ones, the use of genebank accessions in breeding programmes is constrained.

In conclusion, the pre-breeding process detects a valuable trait in unadapted materials, "captures" its genetic diversity, and incorporates those genes into a usable form via various methods.

Future prospects:

Due to the heightened risk of extinction for endemic and narrowly adapted species, it is urgent to collect, characterise, and document wild species, especially crop wild relatives. For agricultural adaptation to biotic and abiotic challenges, including the requirement for adequate screening of germplasm for various features including quality traits and biofortification, there is a rising demand for novel genes in germplasm/genebank collections. The wheat and barley genome mapping and synteny of the sequenced genes can be used to identify the genes encoding abiotic stress tolerance and can be applied to crop improvement. Utilizing the capability of genetic transformation techniques, the desired gene(s) might be transferred from the tertiary gene pool and/or beyond. To make better use of the knowledge acquired from genetic and genomic analysis programmes for dealing with complex traits, new breeding techniques and bioinformatics tools are needed.

■■■

SYNTHETIC SEEDS IN AGRICULTURE

Pooja Singh*
Deptt. of Agronomy
Rupesh Kumar
Deptt. of Vegetable Science
SVPUAT, Meerut (U.P.)

Synthetic seeds are artificially encapsulated somatic embryos, shoot buds, cellaggregates.

Tissue types to produce artificial seeds-

Somatic embryos: These are the best when you want to follow clonal propagation. Normal seeds develop as a result of sexual recombination and so they produce genetically different plants. However, somatic embryos are produced from somatic or vegetative cells that help to produce genetically identical plants.

Axillary shoot buds and apical shoot tips: These tissues do not possess root meristem so they need to be induced for root development after encapsulation.

Embryogenic tissues: These tissues are best when you want to proceed with clonal propagation and genetic transformation studies. But, their maintenance is labor-intensive and costly.

Protocorms: These are mainly used in the case of orchids. The protocorms are encapsulated in sodium alginate gel to form synthetic seeds.

Application of synthetic seeds-

1. To transport pathogen-free propagules.
2. Male and female sterile plants can be propagated for hybrid seed production.
3. They can be used for the multiplication of transgenic plants.
4. Synthetic seeds are used in the multiplication of non-seed producing plants, ornamental hybrids, and polyploids.
5. They can be used to propagate endangered plant species.
6. The cryopreserved synthetic seeds can be used for germplasm preservation.
7. Synthetic seeds can be used to maintain genetic uniformity and varieties of crops.
8. The synthetic seeds technology can be used to produce improved food crop varieties and produce environmentally friendly plantations.

Advantages of synthetic seeds-

1. They act as a channel to develop a whole new line of plants through biotechnologicaladvances.
2. They maintain the clonal nature of the resulting plants.
3. They are easy to transport.
4. There is the ease of handling while in storage.
5. Synthetic seeds allow economical mass propagation of elite plant varieties.
6. Synthetic seeds are cost-effective compared to traditional seeds.

Disadvantages of synthetic seeds-

1. Only a smaller number of seeds develop into a fully grown plant. This limits the value and application of synthetic seeds.
2. The lack of dormancy and stress tolerance in somatic embryos limits the storage of synthetic seeds.
3. The coating material used in the production of synthetic seeds makes the storage of seeds difficult. Some coatings material used in encapsulation, dry down within a few hours of exposure to the ambient atmosphere.
4. In many plant species, somatic embryos have been found to be sensitive to desiccation.
5. The abnormally germinated somatic embryos can not be used for germination and conversion into normal plants.

■■■

GENE PYRAMIDING

A WAY FORWARD FOR CROP IMPROVEMENT

About Author ...

Parul Gupta*
Himansuman
Ph.D. Research Scholar
Abhay Dashora
Assistant Professor
Deptt. of GPB
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan
Mohit Sharma
Ph.D. Research Scholar
Deptt. of GPB
IARI, New Delhi

The development of molecular genetics and associated technology like marker assisted selection has led to the emergence of a new field in plant breeding-Gene pyramiding. Pyramiding entails stacking multiple genes leading to the simultaneous expression of more than one gene in a variety to develop durable resistance expression. Gene pyramiding is gaining considerable importance as it would improve the efficiency of plant breeding leading to the development of genetic stocks and precise development of broad spectrum resistance capabilities. Watson and Singh (1953) first introduced the concept called gene pyramiding. Gene pyramiding is defined as a method aimed at assembling multiple desirable genes from multiple parents into a single genotype. The end product of a gene pyramiding program is a genotype with all of the target genes. It is mainly used in improving existing elite cultivars for a few unsatisfactory traits, for which genes with large positive effects are identified.

Types of gene pyramiding in plant breeding

Gene pyramiding is a crop breeding strategy that can be used to introduce novel lines by using both traditional and sophisticated molecular breeding programmes The traditional pyramiding method is backcross breeding, which includes crossing a hybrid with one of the parental lines, then selecting for the desired trait By backcrossing, pedigree breeding, or recurrent selection. The inherited qualities and resistance genes are passed from donor parents onto recipient lines. With backcrossing, the traits of interest are identified via the selection process. Resistance gene pyramiding also uses the backcrossing technique. The pyramiding scheme of the genes can be divided into two sections. The first element is called a Pedigree, is designed to include all target genes in a single genotype known as the root genotype. The fixation stage is the second part, which fixes the target genes in a homozygous state to obtain the optimum genotype. A Schematic representation of gene pyramiding given in figure 1.

The molecular technique used in gene pyramiding is Marker assisted selection (MAS), Marker assisted backcross breeding (MABB), and Marker assisted recurrent selection (MARS). By using marker-assisted selection (MAS), desirable features can be quickly incorporated into new cultivars. Incorporating genes that are significantly influenced by the environment requires the use of molecular markers, or DNA tags, that have been associated to desirable qualities. Molecular breeding practices like as marker-assisted backcross breeding (MABB), a straightforward type of marker-assisted selection, improves a particular attribute by transferring one or more genes or QTLs from one donor parent into another superior cultivar or genotype. This method plays a vital role in backcross breeding for the pyramiding of two or more genes linked with stress tolerance. The marker-assisted recurrent selection (MARS) system is an upgraded method that permits genotype selection and intercrossing in a single crop season.. The pyramiding of numerous QTLs into crops is advised for complex agronomic traits including grain yield and tolerance to biotic and abiotic stress, and expression-QTL (eQTL), protein-QTL (pQTL), and metabolite-QTL (mQTL) types of analyses are used on the multiple traits.

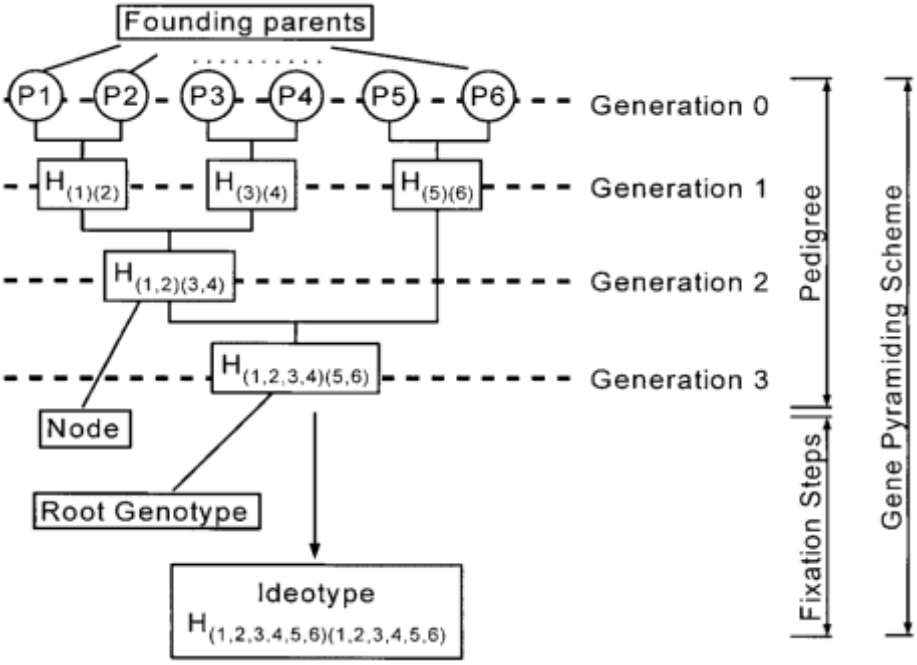


Fig. 1 Diagrammatic representation of gene pyramiding technique

Significance of the gene pyramiding to agricultural sustainability

The gene pyramiding method has made significant contributions to modern agriculture. It has resulted in the development of plant resistance to diseases, insect pests, and abiotic stresses, as well as a sustainable increase in yield. Molecular markers have made it possible for rapid and accurate plant breeding and early generation selection for important features without considerable field research. Through the use of MAS, gene pyramiding has made it possible to integrate a number of genes into a single plant in order to increase production while maintaining the necessary nutritional quality. Modern breeding approaches concentrate on pyramiding many genes or QTLs into a single genotype to ensure long-lasting resistance for sustainable agricultural production because biotic resistance established by a single gene is typically dispersed over a short period of time. An overview of gene pyramiding in significant crop species has been presented in Table 1.

Commercial variety	Donor parent	Gene pyramided	Recurrent parent
Improved pusa basmati	IRBB55	Xa13, Xa21 (BB Resistant)	Pusa basmati -1
Improved Samba Mahsuri	SS1113	Xa5,Xa13, Xa21 (BB Resistant)	Samba Mahsuri
Swarna Sub-1	IR 49830	SUB-1	Swarna
Samba Mahsuri –Sub 1	IR 49830	SUB-1	Samba Mahsuri
Improved Basmati -1	FL478	Saltol (salinity tolerance)	Pusa Basmati -1

Table 1. Commercial examples of gene pyramiding

Conclusion

Around the world, a number of pressures have catastrophic effects on crop production and cultivation. With the aid of molecular markers and MAS techniques, conventional plant breeding has advanced in the modern period. Marker-assisted selection gene pyramiding should be fully explored to minimize the risk of crop yield and quality reduction due to biotic and abiotic stresses. Any innovation in a breeding program is measured on the contribution made towards improvement in crop production. Therefore, in order to accomplish the aims of sustainable agriculture, breeders should utilize MAS gene pyramiding to the fullest extent possible.

DOUBLE HAPLOID TECHNIQUE

USED IN MAIZE BREEDING

About Author ...

Ruchi Bishnoi
Ph.D. Scholar
Deptt. of GPB
College of Agriculture, Agriculture University, Kota, Rajasthan

Double haploid production has become an important tool in plant breeding ,especially in corn breeding due to its capacity to produce completely homozygous plant in one generation. Doubled Haploid (DH) are plants derived from a single pollen grain (haploid) and doubled artificially to form homozygous diploid.

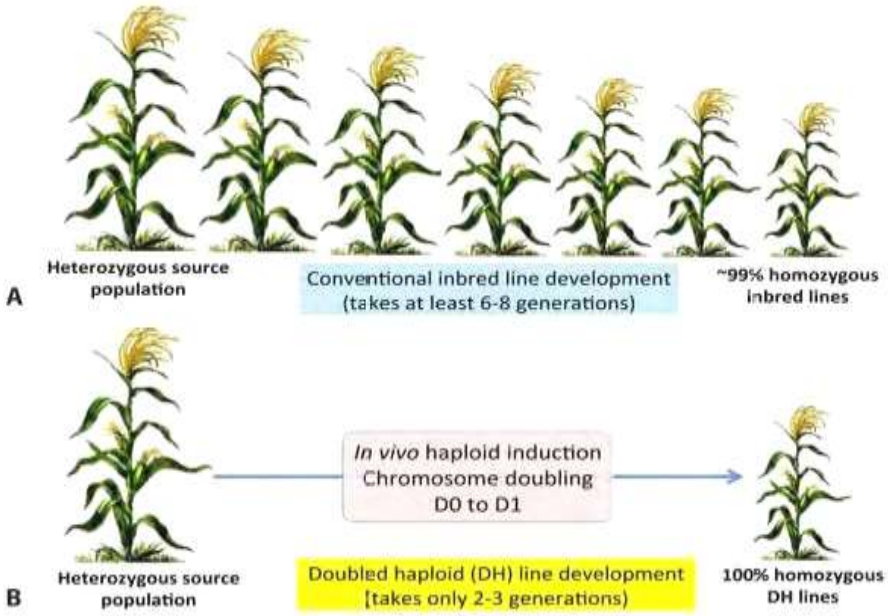


Fig. 1- Schematic diagram of A. conventional method and B. Double haploid method for crop improvement

Haploid plant was first reported by Blakeslee *et al.*, (1922) in *Datura stramonium.* Chase (1952) pioneered the studies on maize monoploids and the use of DH in breeding.

The production of maize DH lines involves the following steps:

1. Induction of haploids.
2. Identification of haploids at seed or seedling stages.
3. Chromosomes doubling in the haploids.
4. Selfing the fertile double haploid plants to produce seed for DH lines.

Haploid inducer:

The "haploid inducers" are specialized genetic stocks which when crossed to a diploid (normal) maize plant, results in progeny kernels in an ear with segregation for diploid (2n) kernels and certain fraction of haploid (n) kernels due to anomalous fertilization. Kernels with a haploid embryo have a regular triploid (3n) endosperm, and therefore, these kernels are capable of displaying germination similar as those kernels with a diploid embryo.

Types of haploid:

1. **Paternal haploids:** The inducer is used as the female and the donor plant as the male parent. Thus, the cytoplasm of paternal haploids originates from the inducer, but the chromosomes exclusively come from the donor plant.
2. **Maternal haploids:** For production of maternal haploids, on the other hand, the inducer is used as the pollinator, leading to haploids carrying both the cytoplasm and chromosomes from the donor.

Table 2. For induction of maize haploid two methods can be used:

In vitro method –Tissue culture Techniques	In vivo –Genetic induction
Anther culture (microspore culture)	Involves use of inducer lines
Low plantlet regeneration rate which dependent on genetic background	High frequency of haploid generation
Highly complex and expensive	Simple to operate
Greatly limited for application in breeding programs	Widely used

Advantages of DH lines in maize breeding

1. DH offers the most efficient and fastest route to produce completely homozygous lines for maize breeding programs.
2. It allows the development of homozygous inbred lines in a single year, compared to conventional breeding.
3. Use of DH lines in combination with molecular marker offers further opportunities for increasing selection gain.
4. In addition, the relatively high genetic variance in DH lines increases response to selection.
5. Complete homozygosity of DH lines allows more accurate phenotypic over multiple locations and years compared to families in early selfing generation (F_3 and F_4).
6. The DH lines from land races and OPVs can be evaluated in replicated trials with high precision, which is not possible when using landraces and OPVs due to their high heterogeneity.
7. DH technology is a highly effective tool to access the genetic diversity present in allogamous landraces and expand the genetic diversity of elite germplasm.
8. When using DH technology, desired numbers of finished inbred lines can be attained at once, eliminating the need for handling larger numbers of breeding materials from different generations of inbreeding.
9. Simplified logistics including less time, labour & financial resources in developing new breeding lines.

Times of Agriculture
Website Stats (Year 2022)
118K Total Pageview
27 K Total Visitor
25 K New Visitor

REPERCUSSIONS OF HEATWAVE ON AGRICULTURE

About Author ...

Anurag Tripathi*
Siddhant Gupta
Shubham Pandey
Kirti Vardhan Pandey

Deptt. of Agricultural Meteorology
College of Agriculture, ANDUAT,
Kumarganj, Ayodhya (U.P.)

The earth's average temperature has been rising. Heat waves have become very intense and frequent globally. In India, the months of March and April 2022, are the warmest on record, witnessed unusual increase in diurnal maximum and minimum temperatures over most parts of the country. Northwest and central Asian country experienced their hottest April in 122 years, with average maximum temperatures reaching 35.9° C and 37.8° C, respectively. Throughout this period, the intense temperatures were found to be higher by +8 to +10.8°C and also the rainfall lower by -60 to -99%, respectively compared to normal in 10 out of 36 meteorological subdivisions.

The early heat waves of 2022 that began on 11 March have impacted 15 Indian states and union territories as of currently. According to IMD heat wave happens once the temperature of an area crosses 40°C within the plains, 37°C in coastal areas, and 30°C within the hills. The weather agency declares a heatwave when an area registers a temperature *i.e.*, 4.5 to 7°C more than normal temperature for the region on that day. If the temperature is over 7°C more than normal, the IMD declares a 'severe' wave.

A new report by Indian Council of Agricultural research has shed light on the extent and sort of crop damage that happened because of the scorching heatwave within the months of March and April 2022. The heatwave had impacted wheat yield and later, a shortage of grain. however, it resulted in poor vegetative and simple growth, pest infestation like fall army and whitefly attacks and viral infections in crops and livestock.

The abnormal increase in maximum and minimum temperature during 2022 impacted crops, fruits, vegetables and animals within the 9 states of, Punjab, Haryana, Rajasthan, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar and Maharashtra. Poor pod setting, wilting and forced maturity, flower drop and poor pollination were observed in rabi crops like gram, maize, chickpea, cowpea and mustard. The hot weather conjointly increased the body temperature of livestock and milch animals by 0.5 to 3.5o C, that reduces milk yield by 15%. Dairy animals faced the problem of increased calf mortality and skin infection.

Rise in temperatures also reduced egg production by up to 10% during the initial 2 days of the heatwave. later, the drop was maintained at about 4-7%, based on ambient temperature.

What is heatwave?

A heatwave is a prolonged amount of unusually high temperatures or weather, as felt by the general public and scientifically defined as an occurrence of temperature greater than normal in a certain region.

Heat wave declaration criteria:

As per IMD, to declare heat-waves, the following criteria should be met minimum in two stations in a meteorological sub-division for atleast 2 consecutive days and it'll be declared on the second day. Heat wave needn't be considered maximum temperature of a station reaches atleast 40oC for plains and atleast 30o C for hilly regions.

- When normal maximum temperature of a station is ≤ 40°C
  - ✓ **Heat wave:** Departure from normal is 5°C to 6°C
  - ✓ **Severe heat wave:** Departure from normal is 7°C or more
- When normal maximum temperature of a station is >40°C
  - ✓ **Heat wave:** Departure from normal is 4°C to 5°C
  - ✓ **Severe heat wave:** Departure from normal is 6°C or more
- When actual maximum temperature remains 45°C or more irrespective of normal maximum temperature, heat wave should be declared.

Impact of heat wave:

- Heat waves exert huge impacts on health, agriculture and availability of water- all usually associated with one another in advanced ways. Agricultural yields get impacted as well. For instance, the wheat crop in the current rabi season in Punjab, Haryana and Uttar Pradesh has been impacted by heat waves. Several farmers have reportable losses between twenty per cent and sixty per cent in these states. This happened because the heat waves arrived early this year and the temperatures affected the wheat crop throughout their growth stage, resulting in shrivelled grains that fetch lower price within the market, resulting in losses.
- The unlikely impact of current heat waves would occur in the Himalayan regions of Himachal Pradesh, Jammu and Uttarakhand that these regions would be on the accelerated melting of glaciers because of extreme temperatures which are the main source of water for the people living there.
- D. Sivananda Pai of the Kottayam-based Institute for climate change Studies says that anti-cyclones over western parts of Rajasthan in March and the absence of rain-bearing

western disturbances had triggered the early and extreme heat waves.

- The IPCC report says that every additional 0.5°C of warming can increase hot weather extremes, along with extreme precipitation and drought. Heat waves in India are likely to "last twenty-five times longer by 2036-2065" if carbon emissions stay high and push global temperature rise to 4°C by the end of the century, according to an international climate report published 28 October 2021, covering the G20 countries.

Conclusion:

Due to the efforts of the National Agricultural Research System, many technologies are currently available which can minimise the negative impacts of heat waves in various production systems. The proven technologies are being taken to farmers as a part of Technology Demonstration component of National Innovations in Climate Resilient Agriculture (NICRA). During this year, the technologies were found to be promising in minimising the impact of heat stress. In addition, strengthening the weather forecasts and Agro-advisory services can help farmers taking informed decision about the impending weather. And to reduce agricultural losses because of heat waves, heat-tolerant varieties need to be developed. Building capacities of farmers and large-scale awareness on climate resilient technologies is required for enhancing their adoption.

Times of Agriculture

Times of Agriculture

Times of Agriculture

Times of Agriculture

SCAN ME