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KERALA KARSHAKAN

English journal

The First English farm journal from the house of Kerala Karshakan

Celeriac

Unsung Vegetable

INSIDE

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Celeriac
Unsung Vegetable

Introduction

Celeriac (*Apium graveolens var. rapaceum*) is a root vegetable crop of the celery plant. It is also known as celery root or turnip rooted celery. Celeriac is an umbelliferae or apiaceae plant with the chromosomal number 2n=22. In nature, the plant is biennial to perennial, however it is commercially produced as an annual. Celeriac has a short stem with a bulging hypocotyl-like knob which is

cream brown in color and has cream white flesh. The root has an approximate diameter of 10-12cm with a rough and ridged texture. Celeriac is comparable to celery, however it produces root and has a taste that is similar to celery. Growing procedures are identical to turnip, although root production takes a long period, typically 90-120 days. Its leaves are compound (made up of two or more separate leaflets) since it belongs to the apiaceae family. It blossoms in the second year of planting, and seed generation is only feasible in temperate regions.

Origin and distribution

Celeriac originated in the Mediterranean area and spread to northern Europe. Celeriac, a wild descendant, is also found in temperate climates and is grown in Germany, North America, North Africa, and South West Asia. It possesses medical benefits that civilians in Italy, Greece, and Egypt have described. Celeriac is also mentioned in the Home Odyssey of 850 BC. In 1623, it was first documented as a food plant in France. About 1600 BC, French and Swiss botanists noted the value of celeriac. Celeriac is well-known in Europe by the seventeenth century. It is now grown all over the globe.

In India Celeriac is mostly grown in the foothills of the northwestern Himalaya and other parts of Panjab, Himachal Pradesh, and Uttar Pradesh. The majority of celeriac is produced from the state of Punjab.

Related species

Based on different botanical descriptions made by using consideration of various plant parts consumed, these varieties are classified as:

1. *Apium graveolens var. dulce,* (celery): it has succulent, solid petiole which generally used in salad purpose.

2. *Apium graveolens var. rapaceum*, (celeriac or root celery): It developed swollen hypocotyl or knob root which

generally used in soup, strews, and grated salad.

3. *Apium graveolens var. scalinum*, (smallage or leaf celery): It has a major portion of leafy part with often hallow petiole, leaves are used in condiments and for medicinal purpose.

Breeding approaches

Celeriac breeding goals are mostly determined by the local market and celeriac growers. Common breeding characteristics include high and uniform output, improved bolting resistance cultivar, larger hypocotyl and excellent and long storage character. Breeding celeriac is considerably more pushed in European nations than in other countries, with the primary goal of developing hybrid breeding and exploiting heterosis. Screening of diverse wild related material and exploration of novel germplasm to generate varieties that can thrive in high temperatures and can also be grown in tropical regions. To improve the therapeutic value by increasing the content of secondary metabolites. Mostly cultivated area of celeriac are found in European countries but now it cover most part of world. Here are some varieties of celeriac which farmers can grow:

1. Alabaster: It is celery flavor variety and bulb retain its color when it cooked.

2. Brilliant: Round root with medium to small size.

3. Giant Prague: Large and white colour root with strong celery flavor.

4. Mars: Big and uniform root.

5. Monarch: Easily grown, smooth texture and can eat as raw or cooked.

6. Prinz: small plant with smooth white skin.

Some other varieties are: Marble ball, Iram, Tellus, Claudia, Jose, Globus, Diamant, Ibis, Kojak etc.

Therapeutic value

There are 38 volatile compounds detected in celery

Nutritional value

Celeriac is a reputable medicinal plant and low calory food, rich in fibres, minerals calcium, magnesium, iron and vitamins like B, C, K and flavonoids (Fazal and Singla, 2012).

Nutrition Composition of celeriac vegetable (per 100 g Edible Portion)

Energy	42 kcal
Water	88%
Carbohydrates	9.20g
Protein	1.50g
Fat	0.3g
Dietary fiber	1.8g
Sugar	1.60g
Vitamin C	8.0 mg
Vitamin B	0.165 mg
Vitamin K	41 μg
Calcium	43 mg
Magnesium	20 mg
Sodium	100 mg
Iron	0.7 mg

Sources: U.S. Department of Agriculture (2018)

juice, including aldehydes, esters, alcohols, terpenes, and phthalides (Gold and Wilson,1963). Celeriac is high in antioxidants, which help to protect cells from damage caused by free radicals. When celeriac is eaten raw as a salad, it has a high concentration of ascorbic acid, which acts as an antioxidant and strengthens the immune system. Celeriac has a high concentration of vitamin K, which is essential for heart health and blood clotting. It contains adequate dietary fibre to aid digestion and enhance bowel movement. Calcium and phosphorus increase bone health.

Celeriac roots and seeds have beneficial therapeutic properties, acting as a diuretic, stimulant, carminative, anti-inflammatory, sedative, and tonic. It also aids in menstruation and increases milk production in breast-feeding women. Since it is low in calories and fat, it may be used by those who are overweight. Celeriac seed has aphrodisiac properties and is also used as an insect repellant.

Economic importance

Celeriac may be eaten raw in salads and coleslaws, as well as roasted, boiling, and baked forms. This vegetable may also be boiled and mashed and can be a substitute for potatoes and other root vegetables. Celeriac root and leaves are regularly consumed as vegetables all over the globe. It is often used as a garnish, stuffing, and in baked meals. Since its flavors are comparable to celery, it may be used to flavor soup, strew, and tomato juice.

Conclusion and future trust

Fundamentally, celeriac is an underused crop right now,

but it offers a lot of health advantages, food variety, and medicinal properties, therefore we should promote breeding and improvement programs. Since no breeding variants have been produced in India, scientists must create new types for farmers, household gardens, and market diversity. Celeriac is only planted in temperate regions, however certain cultivars can endure high temperatures and may be grown in tropical areas as well. It has extremely excellent therapeutic properties and may be used in the pharmaceutical sector as well as the production of ayurvedic medications. Standardize quality seed production techniques to provide an efficient seed chain from breeder to farmer.

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APPLICATION OF DRONES IN AGRICULTURE

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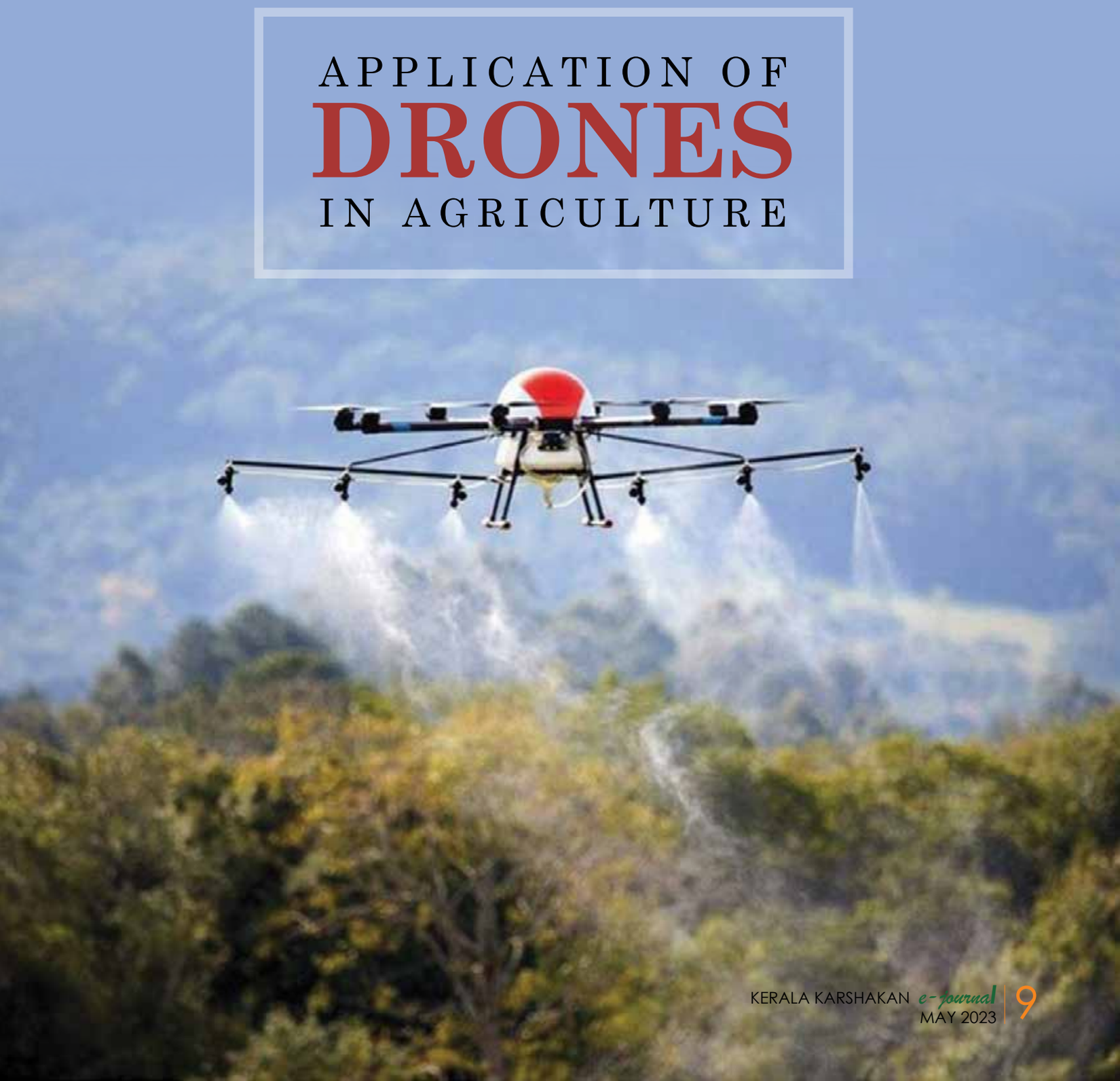
Introduction

India is primarily an agrarian economy. Agriculture remains the chief source of income for the majority of the rural households. India's economy is also heavily dependent on the agricultural produce that constitutes a major portion of its exports as well. However, despite mounting importance of agriculture, the sector is still far behind in technological advancements. Crop failure due to adverse weather conditions and uncontrolled pest issues have been the key contributor to this scenario. Moreover, Indian farmers are even now



dependent on monsoon rains for irrigation and use age-old methods for farming practices. Hence, the quality and quantity of agricultural produce is sometimes compromised in spite of the relentless efforts by farmers.

Drones and the Indian agriculture industry

Drones are uncrewed aerial vehicles (also known as UAVs), which are used for surveillance in various industries. Till now, they were primarily used by companies working in industrial sectors such as mining and construction, army, and hobbyists.But now, drone technology is increasingly available for use in various sectors of agriculture as well. Though the technology is still nascent in India, many companies are trying for its easy availability to Indian farmers and ready to be used to increase efficiency in agricultural production.

Advantages of Using Drones in Agriculture

According to recent research, the global drone market within agriculture would grow at 35.9% CAGR and reach $5.7 billion by 2025. This emerging technology can help reduce time and increase the efficiency of the farmers. The use of drones in the agricultural sector is only expected to rise as the industry matures, and so it is good to know how to use this technology judiciously.

Soil and field analysis

For efficient field planning, agricultural drones can be used for soil and field analysis. They can be used to mount sensors to evaluate moisture content in the soil, terrain conditions, soil conditions, soil erosion, nutrient content, and fertility of the soil.

Crop monitoring

Crop surveillance is the supervision of crop progress from sowing to harvest. This includes providing fertilizers at the right time, checking for pest attack, and monitoring the effect of weather conditions. Crop surveillance is the only way that a farmer can ensure a timely harvest, especially when dealing with seasonal crops. Any errors at this stage can result in crop failure. Crop surveillance helps in understanding and planning for the next farming season. Drones can help in effective crop surveillance by inspecting the field with infrared cameras and based on their real-time information, farmers can take active measures to improve the condition of plants in the field.

Plantation

Drones can help in planting trees and crops, which

was done by farmers before. This technology will not only save labor but also help in saving fuels. Soon, it is expected that budget-friendly drones will be used instead of huge tractors, as they emit harmful gases and pollute the environment in the process.

Livestock management

Drones can be used to monitor and manage huge livestock as their sensors have high-resolution infrared cameras, which can detect a sick animal and swiftly take actions accordingly. So, the impact of drones on precision dairy farming is soon to become a new normal.

Crop spraying

Agri-drones can be used to spray chemicals as they have reservoirs, which can be filled with fertilizers and pesticides for spraying on crops in very little time, as compared to traditional methods. Thus, drone technology can usher in a new era for precision agriculture.

Check crop health

Farming is a large-scale activity that takes place over acres of land. Constant surveys are necessary to monitor the health of the soil and the crop that has been planted. Manually, this may take days, and even then, there is space for human error. Drones can do the same job in a matter of hours. With infrared mapping, drones can gather information about both the health of the soil and the crop.

Avoid overuse of chemicals

Drones can prove to be especially effective in reducing the overuse of pesticides, insecticides, and other chemicals. These chemicals indeed help to protect the crop. But, their overuse can prove to be detrimental. Drones can detect minute signs of pest attacks, and provide accurate data regarding the degree and range of the attack. This can help farmers calculate the required amount of chemicals to be used that would only protect the crops rather than harming them.

Prepare for weather glitches

Weather conditions can prove to be a farmer's best friend and worst enemy. Since these cannot be accurately predicted, it becomes extremely difficult to prepare for any shift in patterns. Drones can be used to detect upcoming weather conditions. Storm drones are already being used to make better predictions. This information can be used by farmers to be better prepared. Advance notice of storms or lack of rain can be used to plan the

crop to be planted that would be best suited to the season, and how to take care of planted crops at a later stage.

Monitor growth

Even when everything is going according to plan, crops need to be surveyed and monitored to ensure that the right amount of yield will be available at the time of harvest. It is also important for future planning, whether it is about determining the right price for the open market, or harvesting cyclical crops. Drones can provide accurate data about every stage of the crop growth, and report any variations before they become a crisis. Multispectral images can also provide accurate information about the subtle differences between healthy and unhealthy crops that may be missed by the naked eye. For example, stressed crops will reflect less near-infrared light as compared to healthy crops. This difference cannot be detected by the human eye always. But drones can provide this information in the early stages

Geofencing

The thermal cameras installed over drones can easily detect animals or human beings. So, drones can guard the fields from external damage caused by animals, especially at night.

Critical parameters to be considered for drone based pesticide the application

i) Only central insecticide board and registration committee (CIB&RC) approved pesticides/ insecticides shall be used.

ii) The dose has to remain within the range approved by CIB & RC

iii) The Pesticides/Insecticides (liquid or solid) compatibility with the drone spray system shall be established prior to the mission for the desired dilution. This is to ensure pesticide/insecticide solubility formulation stability and ability to spray with the type of nozzles provided in the drone. In case of mixing of more than one Pesticides/Insecticides, CIB&RC specified guidelines must be adhered to.

iv) The minimum dilution shall be decided based on the fulfillment of the above-mentioned requirement and ensuring satisfactory coverage of sprayed input both horizontally and vertically

v) Pesticides/Insecticides should be diluted only with clean water wherever applicable or with other suitable ingredients as has been approved by the CIB & RC.

Benefits of agri-drones

Security

The drones are operated by trained drone pilots. So, there are no chances of their misuse.

High efficiency

Drones do not have any operational delays and can work double the speed of human labor.

Water-saving

In comparison to traditional spraying methods, agricultural drones use ultra-low volume (ULV) spraying technology, thus saving more water.

Low cost and easy to maintain

Agri drones are sturdy, low in cost, and require minimum maintenance. Some of the key features include a detachable container, low-cost frame, precise spraying of pesticides.

Enhanced Production

The farmer can improve production capabilities through comprehensive irrigation planning, adequate monitoring of crop health, increased knowledge about soil health, and adaptation to environmental changes.

Effective and Adaptive Techniques

Drone usage results in regular updates to farmers about their crops and helps develop strengthened farming techniques. They can adapt to weather conditions and allocate resources without any wastage.

Greater safety for farmers

It is safer and more convenient for farmers to use drones to spray pesticides in terrains challenging to reach, infected areas, taller crops, and power lines. It also helps farmers prevent spraying the crops, which leads to less pollution and chemicals in the soil.

10x faster data for quick decision-making

Drone surveys back farmers with accurate data processing that encourages them to make quick and mindful decisions without second-guessing, allowing farmers to save the time invested in crop scouting. Various sensors of the drone enable capturing and analyzing data from the entire field. The data can focus on problematic areas such as infected crops or unhealthy crops, different coloured crops, moisture levels, etc. The drone can be fixed with several sensors for other crops, allowing a more accurate and diverse crop management system.

Less wastage of resources

Agri-drones enables optimum usage of all resources such as fertilizer, water, seeds, and pesticides.

99% accuracy rate

The drone survey helps farmers calculate the precise land size, segment the various crops, and indulge in soil mapping.

Useful for insurance claims

Farmers use the data captured through drones to claim crop insurance in case of any damages. They even calculate risks and losses associated with the land while being insured.

Evidence for insurance companies

Agricultural insurance sectors useAgri-drones for efficient and trustworthy data. They capture the damages that have occurred for the right estimation of monetary payback to the farmers.

Limitations of agri drones

Connectivity issue

Often, online coverage is unavailable in rural areas. Under such circumstances, a farmer needs to invest in internet connectivity, which can turn into a recurring expense.

Weather dependent

Drones do not have any operational delays and can work double the speed of human labor.

Weather dependent

Drones are heavily dependent on good weather conditions. Under rainy or windy conditions, it is not advisable to fly drones.

Knowledge and skill

Using new technology is a welcoming change but using it daily requires the right skillset and adequate knowledge. An average farmer may struggle to understand drone functions. Either he must acquire the knowledge or remain dependent on an experienced person.

WATER MANAGEMENT AND ITS APPLICATIONS IN URBAN HORTICULTURE

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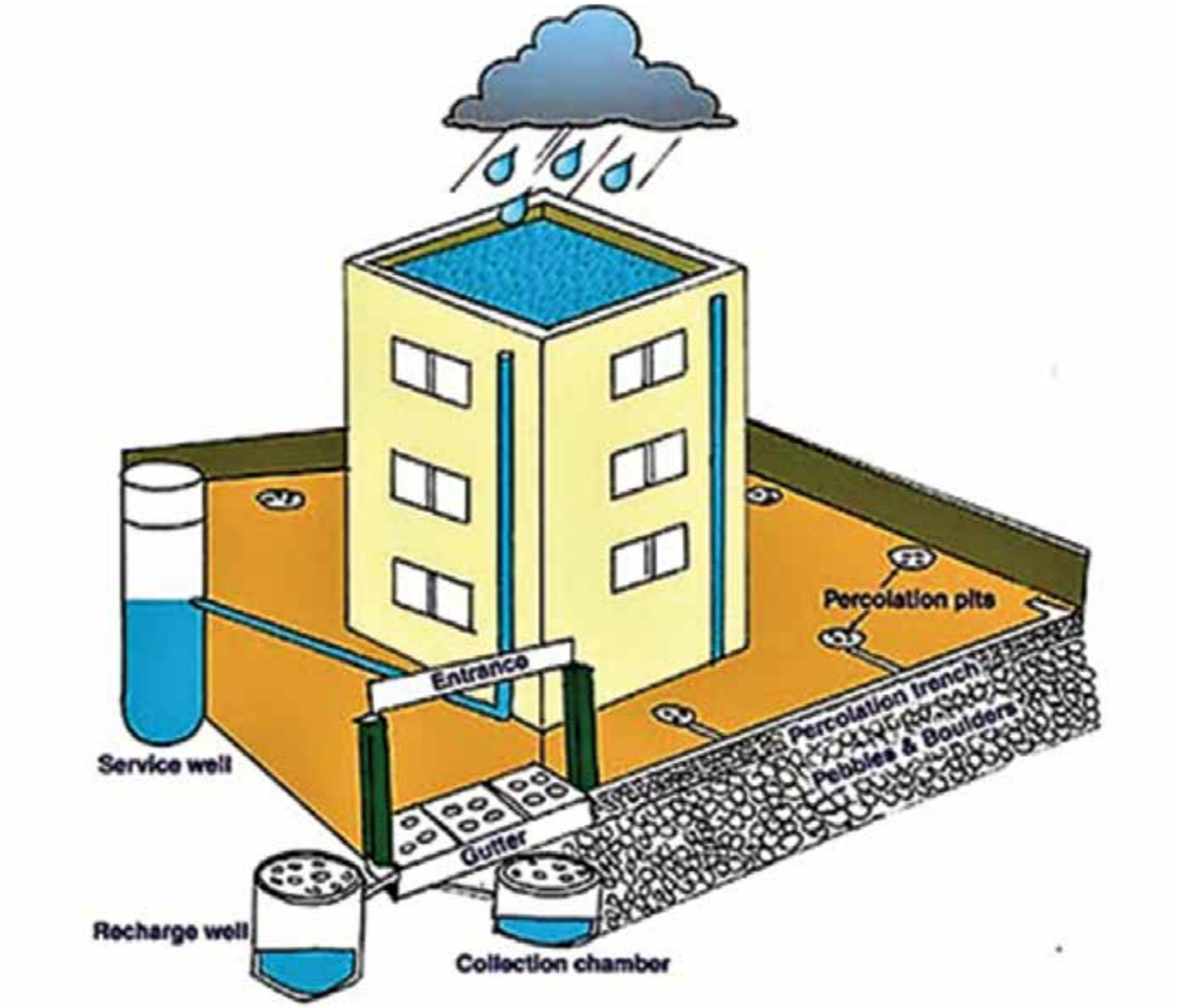
Introduction

Urban farming has been practiced throughout the world since the dawn of urbanization. Indeed, farming and urbanization are deeply interconnected, with farming allowing for the creation of cities, and cities requiring farming to feed the urban population (Mougeot, 2005;



Steel, 2013). Urban farming, therefore, contributes to the sustainability of cities in various ways, socially, economically, and environmentally. Several researchers have found that urban farming is increasingly being practiced in parts of Asia, Africa as well as in both South and North America; South and East Asia comprise 49% of urban-irrigated croplands globally (Thebo, Drechsel, &Lambin, 2014).

Sustainable water management (SWM) is a critical component. Increasing population growth leads to an increasing demand for water – both at the household level and in the industries and services that support the growing population.

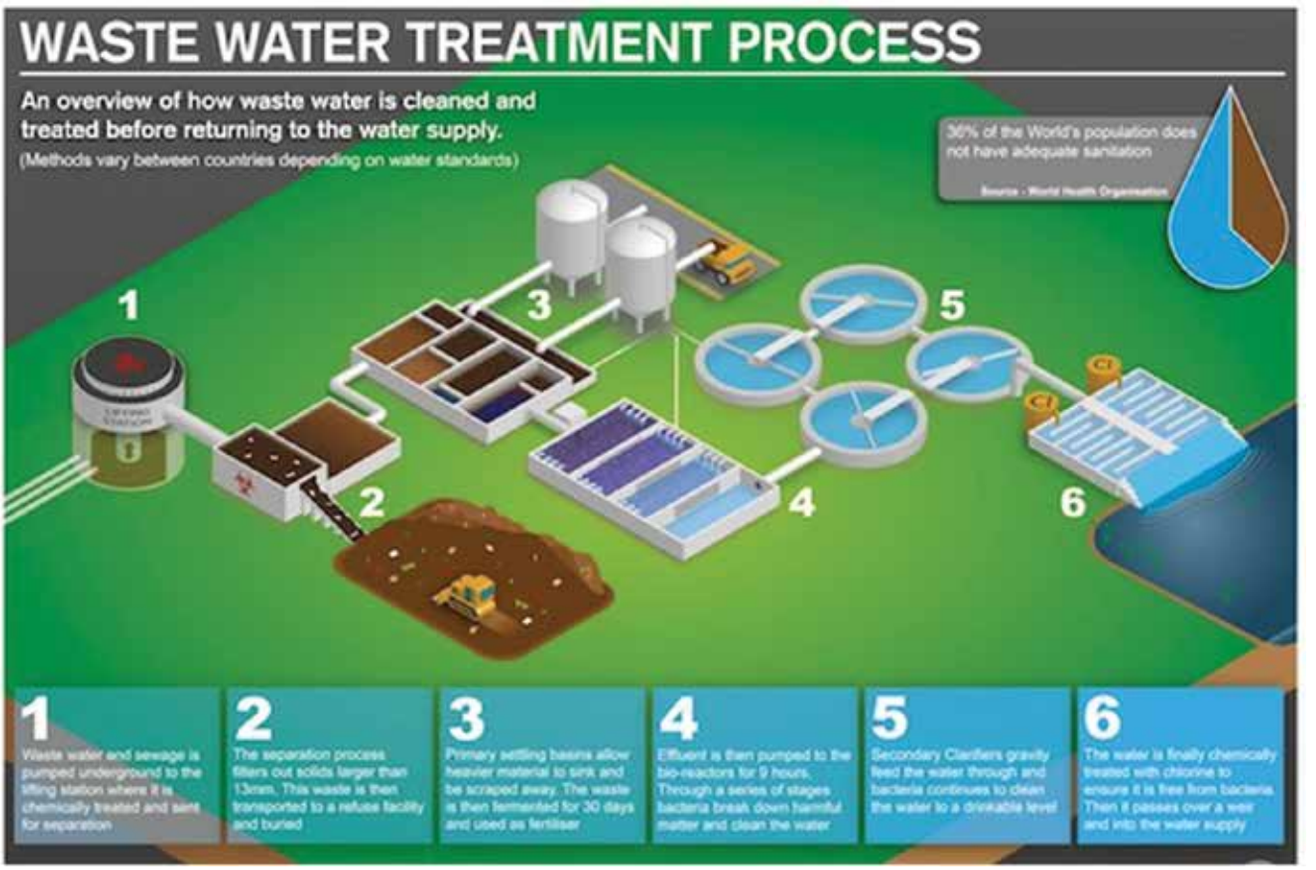
Components of Water management

1. Available water
2. Growing medias
3. Water saving devices

1.Available water

Tap water is used in public gardens. Groundwater and surface water abstraction are likely to be the dominant water sources for most gardens but tap water will still be a significant factor, particularly for smaller public gardens and gardens without a borehole/river system nearby. Both abstraction, particularly from surface water bodies, and tap water use in public gardens place pressures on water resource management and the wider environment, particularly as levels of surface water abstraction are considered unsustainable in many water bodies and likely to face

Weather based irrigation controller



restrictions in the future.

Roof water harvesting: Rooftop rainwater harvesting (RTRWH) is the most common technique of rainwater harvesting (RWH) for domestic consumption. It can be done easily, doesn't cost much and is applicable at small-scale with a minimum of specific expertise or knowledge; or in more sophisticated systems at large-scale (e.g. a whole housing area). Rainwater is collected on the roof and transported with gutters to a storage reservoir, where it is either used for groundwater recharge or provides water at the point of consumption. Rainwater harvesting can supplement water sources when they become scarce or are of low quality like brackish groundwater or polluted surface water in the rainy season. However, rainwater quality may be affected by air pollution, animal or bird droppings, insects, dirt and organic matter. Therefore regular maintenance (cleaning, repairs, etc.) as well as a treatment before water consumption (e.g. filtration or/and disinfection) are very important.

Rainwater harvesting system consists of at least the following components

- Catchment area or roof surface to collect rainwater
- Delivery systems (gutters) to transport the water from the roof or collection surface to the storage reservoir
- Storage reservoirs or a tank to store the water until it is used.
- An extraction device or a infiltration device in case the collected water is used for well or groundwater recharge

Waste water: Domestic treated wastewater are valuable and can be reutilized in urban horticulture as a potential strategy to provide communities with access to fresh produce. Reutilization of nutrients and water from domestic treated wastewater to urban horticulture provide access to fresh/healthy foods. Engineered physical and biochemical treatment processes can help to remove pathogens, thereby mitigating some of the health risks of urban wastewater agriculture (Asano 1998). The construction and operation of these centralized wastewater

Soil water monitoring

treatment plants use energy and emit associated greenhouse gases (GHGs), which are considered as an investment that can mitigate the health risks associated with resource reutilization when wastewater is treated and reused in agriculture.

2.Growing medias

A potting mix also must have ingredients that help to retain moisture. This is where organic materials, usually peat moss, sphagnum moss, or coir come in. They cling to some of the water that the aggregates are helping to drain. Organic materials also hold on to nutrients that might otherwise wash away. Improve or make your own potting mix by adding moisture-holding ingredients like coco peat (rehydrated coconut fibre). It's hydrophilic or 'water-loving'.

Weather based irrigation controller

Vermiculite also holds moisture, minerals and is an efficient insulator. These ingredients may help to extend the time between watering.

Coco peat: It is a by-product of the coconut industry and it is used widely as a substrate due to its low cost, aeration, drainage and long life. It is supplied in loose form as well as in compressed brick forms. These are easy to transport at low costs. The bricks weigh about 4–5 kg and can expand to 4–5 times of their volume once water is added after loosening them.

Vermiculite: It is an aluminum–iron–magnesium silicate complex. It is a mica-like mineral which expands to open-flake structures on heating at high temperatures.Vermiculite is available in various grades and particle sizes and can have a bearing on the choice, depending upon the size of nursery pots. Vermiculite has a range of pore spaces, which can retain considerable amount of moisture on wetting.

Perlite: It is a crushed volcanic rock that has been heated and expanded to become a lightweight, white material. Perlite is sterile and has a neutral pH. It improves air space and water drainage of the nursery medium. It does not break apart easily. It can hold about 3–4 times of water equal to its weight in water. Use of perlite keeps the weight of the media lesser in comparison to soil.

Sphagnum Peat moss: It is also called peat moss or simply peat. Peat is the most popular component of most soilless substrate media or mixes, used as soilless medium because of its lower cost and easy availability. It originates from the partial decomposition of plant material in peat bogs where oxygen availability is low. All the peats have very favourable water-holding capacity.

Bark: It is a by-product of saw mills, which is used as a media for pot cultures as well as in greenhouses. It provide aeration at low cost. It is either used alone in containers or mixed with one-fourth part of peat moss for improving water-holding capacity. Bark particles of less

than 3/8 inch (9.5 mm) in size are used as growing media in general. Bark has low nutrients and very low pH (3.5–6.5) when used unprocessed.

3. Water saving devices

The ever increasing global food demand and the problem of water shortage makes irrigation water management a necessity, if we have to satisfy our food demand in the face of dwindling water resources. In many parts of the world where irrigation is practiced, particularly arid and semi-arid regions, the main challenge is that of water shortage caused by drought or water mismanagement. The knowledge of the content of water in a crop could improve water resources management, bringing water to the crop when and where it's more vital for its development. This is where remote sensing can be useful in irrigation water management. This knowledge of crop water content can be readily provided by remote sensing in an easier and more efficient way than an in situ measurement. Most irrigation fields are quite large ranging from ten to hundred hectares and as such even contemplating ground level measurements may be prohibitive. Remote sensing can allow more efficient irrigation water management by applying water when cro prequires it or when symptoms of water stress appear.

Remote Sensing

Remote sensing in the middle-infra red and thermal infrared portion of the EMR can provide information as to how much water is in the leaves, soil or atmosphere (the three approaches to irrigation scheduling). Water is a good absorber of middle-infrared energy. Therefore, leaves with high moisture content will have low reflectance in the middle-infrared portion. Conversely, high reflectance would signify low moisture content. The usefulness of this to irrigation scheduling is obvious. Utilizing principles of remote sensing, three approaches are used for scheduling irrigation.

Irrigation scheduling has been defined as the use of crop evapotranspiration data and moisture sensors to accurately determine when and how much to irrigate (Leib, et. al., 2002). Irrigation scheduling is the use of water management strategies to prevent over-application of water while minimizing yield loss due to water shortage or drought stress. Since the sole aim of irrigation is to maintain the water status of plants, then it is logical that irrigation should be scheduled by using some measures of plant water status.

The target in scheduling irrigation is to apply the irrigation water when and where the crop is in need. Three approaches can be employed to estimate when the crop needs water. These approaches are soil water monitoring, plant stress monitoring, and whether-based water use predictions.

Soil water monitoring is either labour intensive or equipment intensive whilst weather-based scheduling does not reflect crop type and may overestimate or underestimate a particular crop water requirement.Thus, plant stress monitoring remains the most appropriate way for irrigation scheduling.Nevertheless, the other two may still be used in conjunction with the plant based information. Remote sensing can provide both plant-based,weather-based and the soil-based information.

Conclusion

Whether grown in small gardens or larger fields, using traditional or high-tech practices, horticultural crops have high water requirements. Over the past 20 years, access to water has improved and demand increased in many cities and slums. As a result, water resources have become increasingly scarce in the urban environment. Furthermore, inadequate waste water management has led to progressive degradation of the quality of surrounding water courses and aquifers. So water management in urban areas is very important . Wise and efficient use of available water resources, use of water saving growing media for growing crops, water saving devices used for control irrigation help to ensure adequate quantities of safe water for horticultural production in urban and peri-urban areas.

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Coir yarn

COCONUT COIR

LIVELIHOOD TO SMALL- SCALE INDUSTRY

Coir, also known as coconut fiber, is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, brushes, and mattresses. Coir is strong and durable, making it an ideal material for products that see a lot of wear and tear. India is the world's leading producer of coir, with more than 70% of the global supply coming from the country. The main export markets for Indian coir products are the United States, Europe, and the Middle East. With a large domestic market and a growing export market, there is significant potential for businesses to enter the coir industry in India. This article will provide an overview of the opportunities available for businesses in the coir export sector in India.

The coir industry in India employs more than 150 lakhs

people and has a turnover of ₹4000 crores (US$600 million). The sector is export-oriented, with around 80% of production being exported.

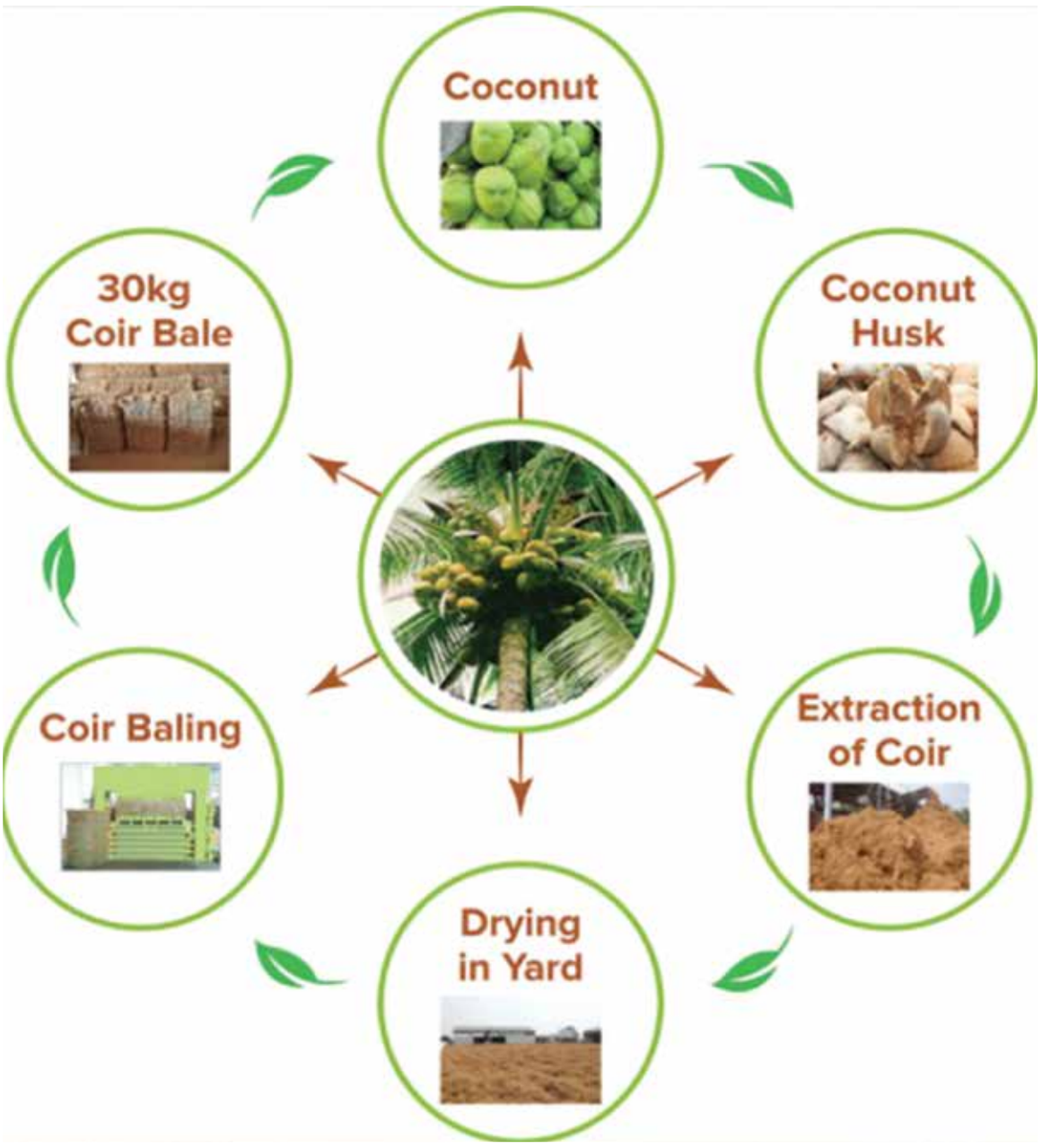
India's Coir Product Export Industry

The coir export industry in India is one of the country's most

Table 1-2. Chemical composition of coir

Lignin	45.84%
Cellulose	43.44%
Hemi-Cellulose	00.25%
Pectin's and related Compound	03.00%
Water soluble	05.25%
Ash	02.22%

Stages in Coir Manufacturing Process



important export industries, with coir products being exported to countries all over the world. India is the world's largest producer of coir and the industry employs millions of people. The coir export industry is worth billions of dollars and it is growing rapidly. The coir export industry is based in Kerala, the world's largest coir producer. The industry is labour-intensive, and most of the workers are women. The coir export industry employs millions of people, and it is an important source of income for the state of Kerala. The coir export industry is growing rapidly, and the demand for coir products is increasing. The industry is facing some challenges, such as the low price of coir products, but it is expected to continue to grow in the future.

India's vast coir resources

India is one of the world's top producers of coir, a natural fiber made from the husks of

(Thampon, 1993)

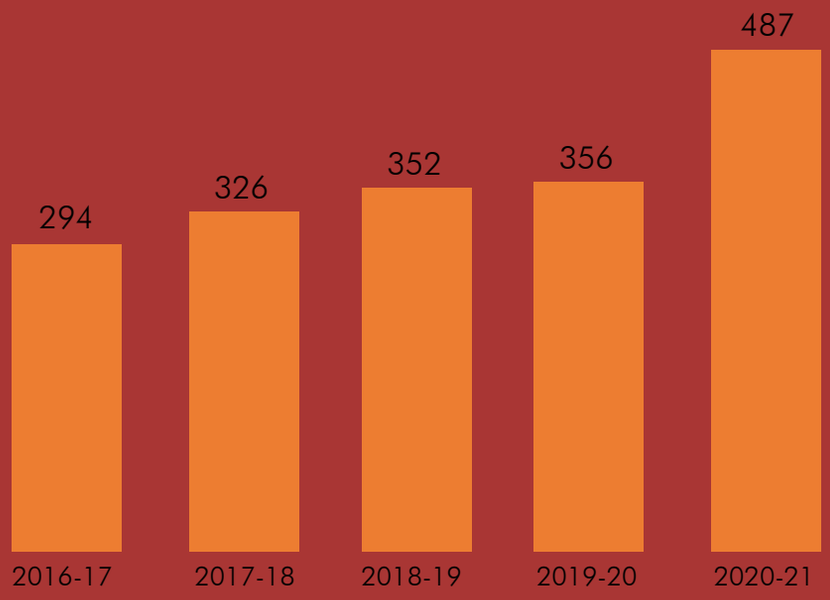


Fig.1. Indian Coir and coir Products export trends

(Source: Coir Board India)

Coir rope

Coir geotextiles

Coir Lawn

coconuts. The country's huge coastal areas and tropical climate are ideal for growing coconuts, and India has an estimated 21 lakh hectares of land under coconut cultivation. In 2021-22, India produced around 200 lakhs tonnes of coconuts, of which around 100 lakh tonnes were used to produce coir. Most of India's coir is produced in the southern state Kerala, which is also the world's largest producer of fiber. Other major coir-producing states in India include Tamil Nadu, Karnataka and Andhra Pradesh. The Indian government is supportive of the coir industry and has implemented several initiatives to promote its growth.

Coir Cricket mat

These include providing financial assistance to coconut growers and coir manufacturers and setting up research and development centers to help improve coir production techniques.

Coconut Husk gives two byproducts i.e. coir fiber and coir pith.

a. Coir fiber: is a byproduct which is obtained from coconut husk.

Extraction from coir fibers

1.Removal of husk from the nut
2.Two distinct trade varieties
a.White coir
b.Brown coir

White coir fiber production:

It is also called as golden fiber it is produced from husk of mature green coconut of 6-9 month by subjecting the husk to retting process of 8-10 months followed by beating of the retted husks with mallet against a log by manual labour for thrashing out pith used for making mats, mattings is also called mated fiber

Brown coir fiber production:

It is produced from dry/ semidry coconut husk by mechanical labour after soaking water for 4-5 days.

- Coir fiber is spun into 2-ply coir yarn using traditional rats (chakras) or by machine.
- The 2-ply coir yarn will be converted into different products on the basis of the need of application.

Application of coir in garden

Roof greening mats: Cooling of buildings by Roof Surface evaporation is an established technology by using coir fiber mat.

Acoustic Barriers: Coir is being used as a noise prevention solution in homes located along highways and other high-traffic roads, in offices and around sporting arenas in Netherlands. This is also used for making stylish compound walls and garden landscaping.

Plant Climbers or Coco poles (Gardening Coir Grow Stick): Coco poles are made by wrapping coir twine around PVC pipes. Coco poles give ideal support to plants while creating a perfect moist environment for its roots. It's ideal for creepers like ornamental plants & even vegetables.

Coir hanging baskets: Are made from coir fibre blended with natural rubber. Coir hanging baskets are used for internal gardening and acts as decorative materials to the buildings.

Coco Lawn: It is a readymade lawn and is an eco friendly method for faster development of readymade lawns using natural coir products instead of using synthetic lawns, which are costly, non-environment friendly and pose disposal problems. The coco lawn is a ready and easy to use eco-friendly alternative for various applications.

Coir geotextile: Geotextiles

Table-3. Export of coir and products from India during the Year 2021-22

Q=Quantity in MT		V= Value in Rs Lakhs		
	2020-21		2021-22	
Item	Q	V	Q	V
Coir Pith	680898	191974.07	696175	225917.69
Tufted Mat	81799	80690.82	92810	100114.57
Coir fibre	354123	62890.57	399428	63655.79
Handloom Mat	20527	24662.10	21079	26172.99
Geo textiles	8583	7059.05	6978	6165.74
Coir yarn	3849	2919.30	4285	3330.73
Curled Coir	9381	2422.22	9943	2622.89
Handloom mattings	1418	1712.00	1110	1423.21
Rubberized Coir	982	1321.41	644	1096.88
Coir Rope	505	491.76	716	649.84
Powerloom Mat	65	106.51	408	753.80
Coir& Rugs Carpet	327	427.90	580	861.79
Coir Other Sorts	744	1200.96	696	1229.56
Power loom mating	11	19.24	4	9.62
Total	1163213	377897.91	1234855	434005.10

(Source: http://www.coirboard.gov.in/)

are the woven and unwoven materials used in ground and civil engineering applications. Coir geotextiles is coir netting woven out of coir fiber.

Advantages of coir geotextiles:

1.It gives protection asoil erosion by rain.

2.Absorption capacity up to 5 times their own weight.

3.Maintains humidity in soil and atmosphere.

4.Biodegradable with time and adds nutrients to the soil.

5.Ability to follow the contours of slope and remains in close contact with the soil.

Business opportunities in the coir industry in India

The coir industry in India offers numerous business opportunities for entrepreneurs and investors. The country is the second-largest producer of coconuts in the world, and coir is a by-product of coconut production. India has a large domestic market for coir products, and the export market is also growing. There is a growing demand for eco-friendly and sustainable products, and coir products are seen as a suitable alternative to synthetic products.

The coir industry offers opportunities for businesses of all sizes. There is a need for small-scale businesses that can provide quality coconuts to processors, as well as large-scale businesses that can process coir and manufacture finished products. There is also a demand for businesses that can provide services such as transportation and storage.

There are several stages in the coir production process, and each offers opportunities for businesses. These include the following:

- Cultivation of coconuts
- Processing coir
- Manufacturing of finished products

There is a need for businesses that can provide quality coconuts, as well as those that can process coir into fiber and other products. There is also a demand for businesses

Coir

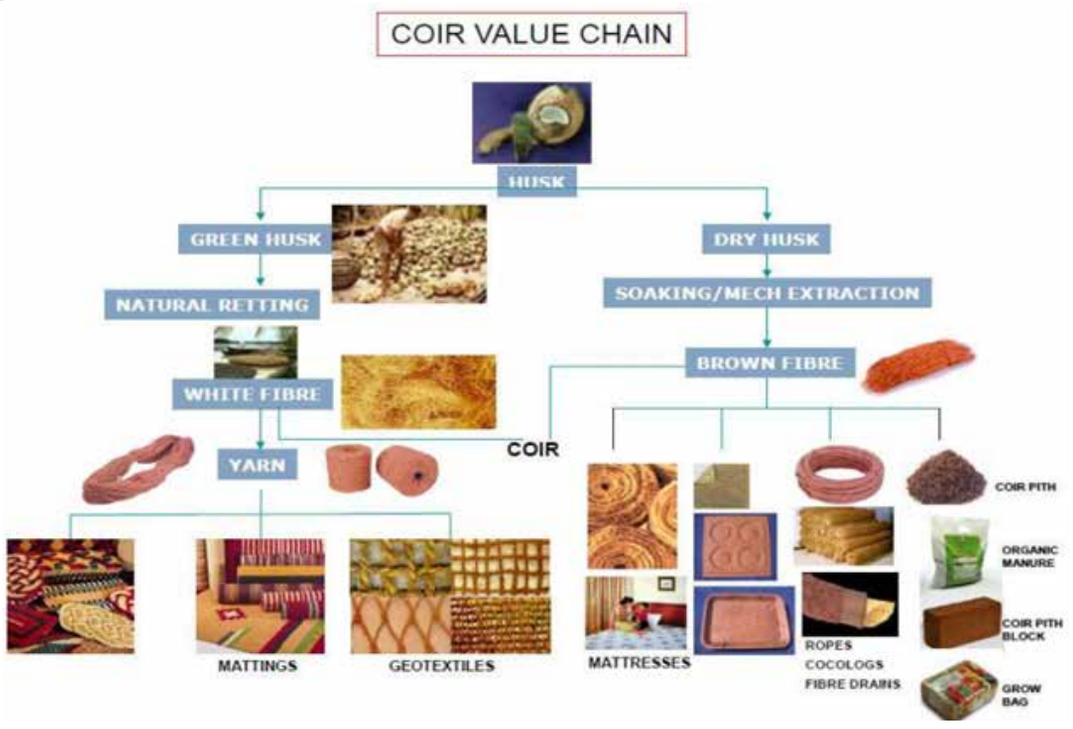
that can manufacture finished products such as mats, ropes, and upholstery. The coir industry is growing, and there is a need for businesses that can provide quality products and services. The industry offers opportunities for entrepreneurs and investors who are looking to start or expand a business.

Coir Export Business in India

Starting a coir export business in India can be a lucrative opportunity, as the country is one of the world's leading producers of natural fiber. Coir, also known as coco peat, is a byproduct of the processing of coconuts. It is used in various applications, including horticulture, construction, and manufacturing. To start a coir export business in India, you will need to obtain a license from the Export Inspection Council of India (EIC). You will also need to register your company with the Export-Import Bank of India (EIBI) and obtain an export-import code (IEC). Once you have obtained the necessary licenses and registrations, you can start sourcing coir from suppliers in India.

How to Find Potential Suppliers for Coir Export?

To find potential suppliers, you can search online directories. You can also contact



the Coir Board of India, which is the nodal agency for the promotion and development of the coir industry in the country. Once you have identified potential suppliers, you will need to negotiate contracts and prices. Once your contracts are in place, you can start exporting coir to your buyers. To ship coir, you will need to obtain an export license from the Department of Commerce.

Benefits of Exporting Coir from India

There are multiple of benefits of exporting coir from India which also includes the following:

- India is the world's largest producer of coir, with a production of about 1.5 million tonnes per year. This gives the country a significant competitive advantage in the global market.
- Coir is an environmentally friendly product made from a renewable resource (coconut husks). It is biodegradable and does not contribute to greenhouse gas emissions.
- Coir is a versatile material with a wide range of applications, including in the construction, automotive, and horticultural industries.
- Exporting coir generates valuable foreign exchange for India. In 2017-18, the country earned around ₹4500 crores (US$ 650 million) from coir exports.
- The coir industry employs millions of people in India, particularly in rural areas.

Future of India's coir export industry

The future of India's coir export industry looks promising. The coir industry is one of the

Coir Basket

(Source:coirkeralafair.com.)

Coir mat

oldest industries in India and is an important part of the country's economy. Coir is a natural fiber extracted from the outer husk of coconuts. It is used in a variety of products, including mats, mattresses, ropes, and nets. India is the world's largest producer of coir. The demand for coir products is growing, especially in developed countries. This is due to the growing awareness of the environmental benefits of natural fibers. Coir is 100% biodegradable and is a renewable resource. It is also resistant to mould and mildew, making it an ideal material for a variety of applications.

Conclusion

India is the world's leading producer of coir products and exports a significant percentage of its production. There is a growing demand for coir products globally, making India an attractive market for investors. Coir products are made from the husks of coconuts and are used in a variety of industries, including construction, manufacturing, and horticulture. There are numerous business opportunities in the coir export industry in India, from manufacturing to trading and exporting. To start a business in this sector, it is important to have a good understanding of the market and the manufacturing process. The Indian government is supportive of the coir industry and has implemented several policies to promote its growth. The government has set up a Coir Board, which provides financial and technical assistance to the industry. It has also implemented a scheme to provide interest-free loans to coir manufacturers and exporters.

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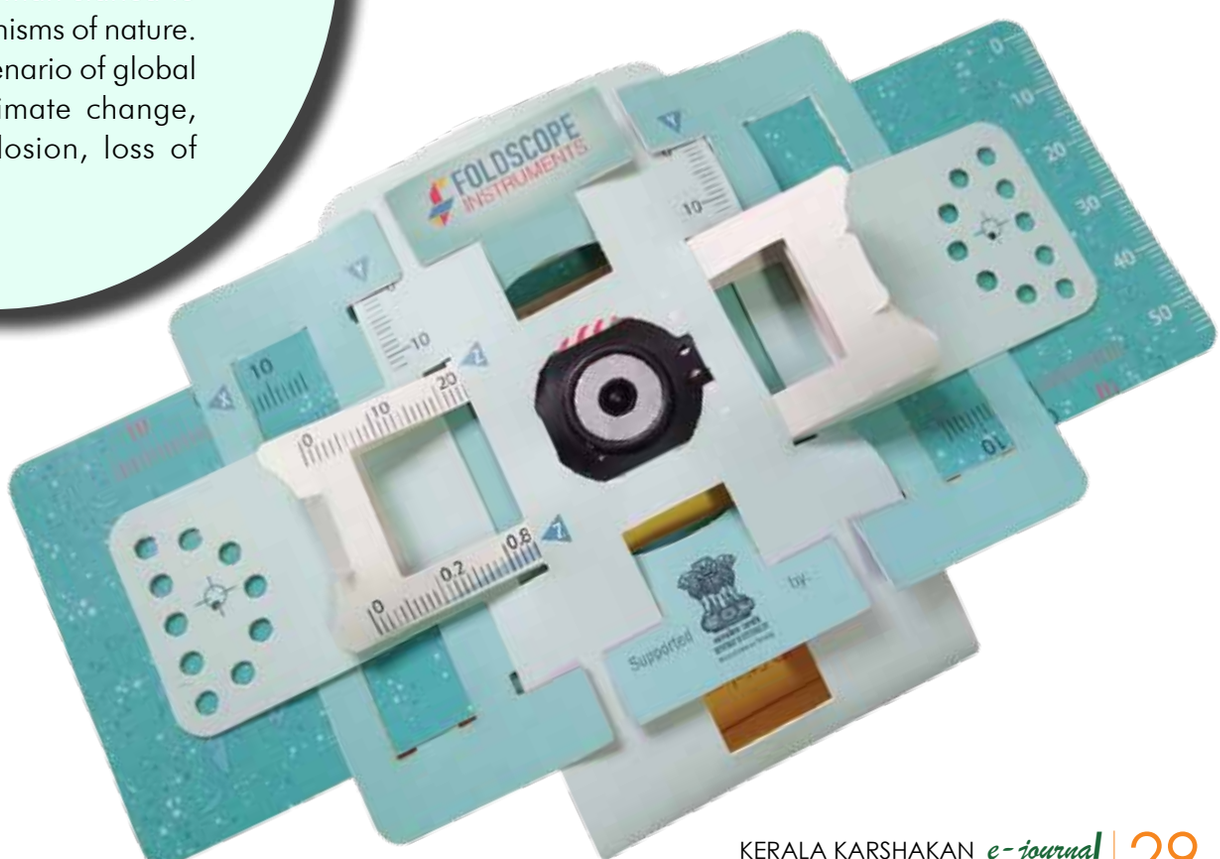
FOLDSCOPE

A COST EFFECTIVE POCKET MICROSCOPE AND ITS UTILIZATION IN PLANT GENETIC RESOURCES MANAGEMENT

Introduction

Plants are vital for different life forms on the planet earth. Research of plant science started during the evolution of humans; more new things were discovered during the course of evolution, when man started to learn the mechanisms of nature. In the current scenario of global crisis due to climate change, population explosion, loss of



biodiversity etc., innovations or research in the field of plant biology (green revolution to gene revolution) helps to meet the demands of food, fodder, fuel, fibre. In the scientific world, plants play a critical role in the scientific breakthroughs. From the single cell organism to multicellular organisms, plants display versatile morphologies to survive in different environments. Microscope has been an integral part of the scientific investigations in plants to unravel the wonders of the plant kingdom; it enables us to see the things that cannot be seen by the naked eyes. A popular saying says "A plant scientist without a microscope is like a soldier without a weapon". The extensive use of the microscopes by plant researchers provided a turning point in the 18th century and botany became largely a laboratory science. Over a period of time, great evolution in microscope from the discovery of lens, simple microscope, compound microscope, electron microscope, Scanning electron microscope (SEM), Transmission electron microscope (TEM) to today's high imaging microscopes is reported (Fig. 1). The application of such technologies to the vast array of unanswered questions in plant development, function, and regulation will be a major goal for plant cell biology researchers in the new millennium. The 20th century witnessed an enormous increase in the rate of growth of botanical research and their outcome. Advanced facilities, technologies in the field of plant sciences resulted in a series of discoveries, concepts, protocols etc.. Nowadays, plant scientists can observe nearly all kinds of samples with appropriate microscopes. Advancements in the recent microscopes made these microscopes costly, heavy, delicate, requires high maintenance, limited to giant laboratories/organizations, needs expertise. This significantly hampers the use by common man, startup labs/institutes and especially in developing countries of the world (Choudhary and Choudhary, 2017). Another major limitation of even simple microscopes is that these cannot be carried to fields.

Knowing the importance of microscope in field and with a philosophy of "microscopy for everyone", a team led by Manu Prakash and his student Jim Cybulski from Stanford University, USA, invented an origami based optical microscope "FOLDSCOPE" that can be assembled from a flat sheet of paper and lens, as a part of the "frugal science" movement which aims to make cheap and easy tools available for scientific use in the developing world (Fig. 2) with cost less than US$ 1 can be affordable for the common

Fig. 1. Revolutionary development in microscope

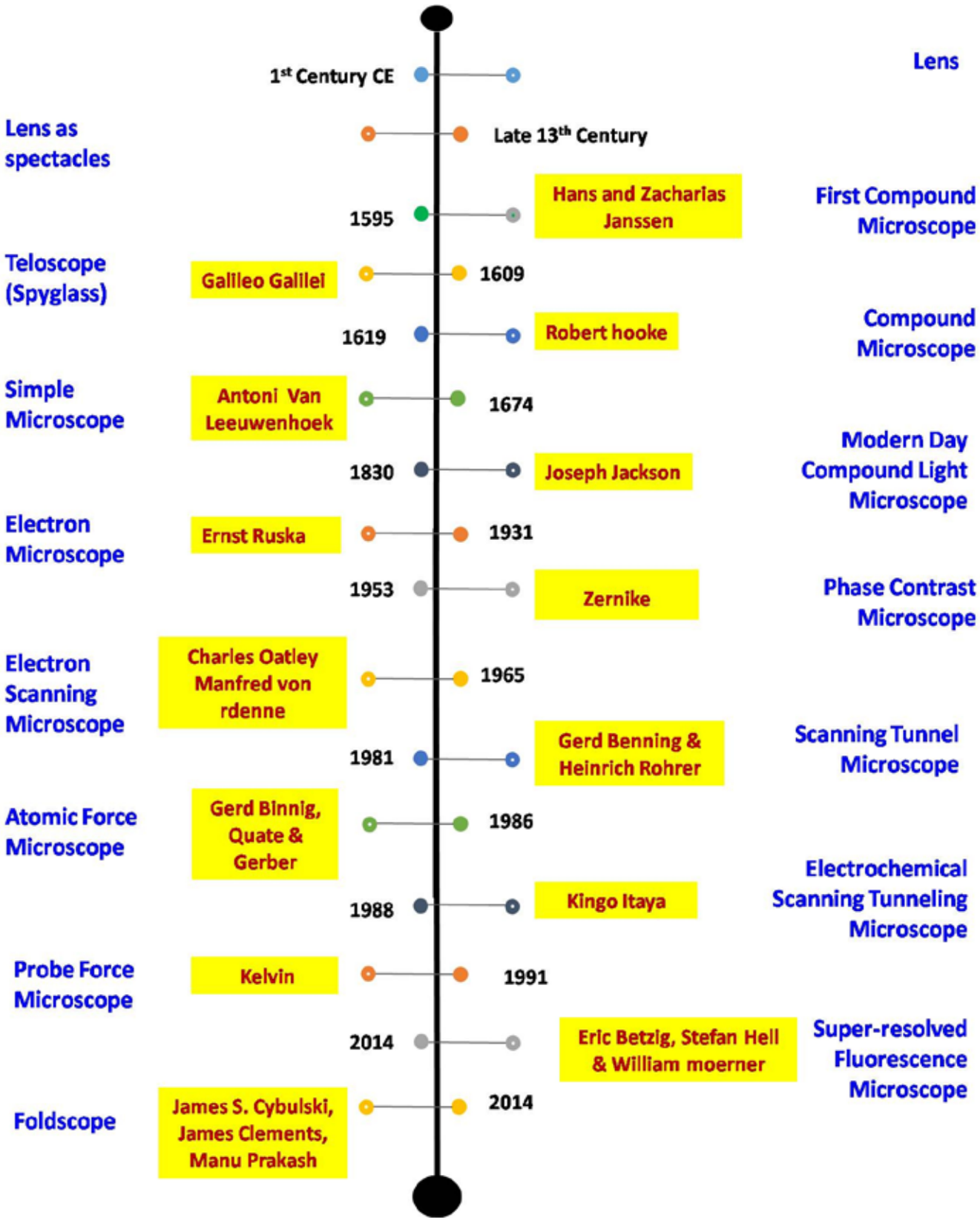
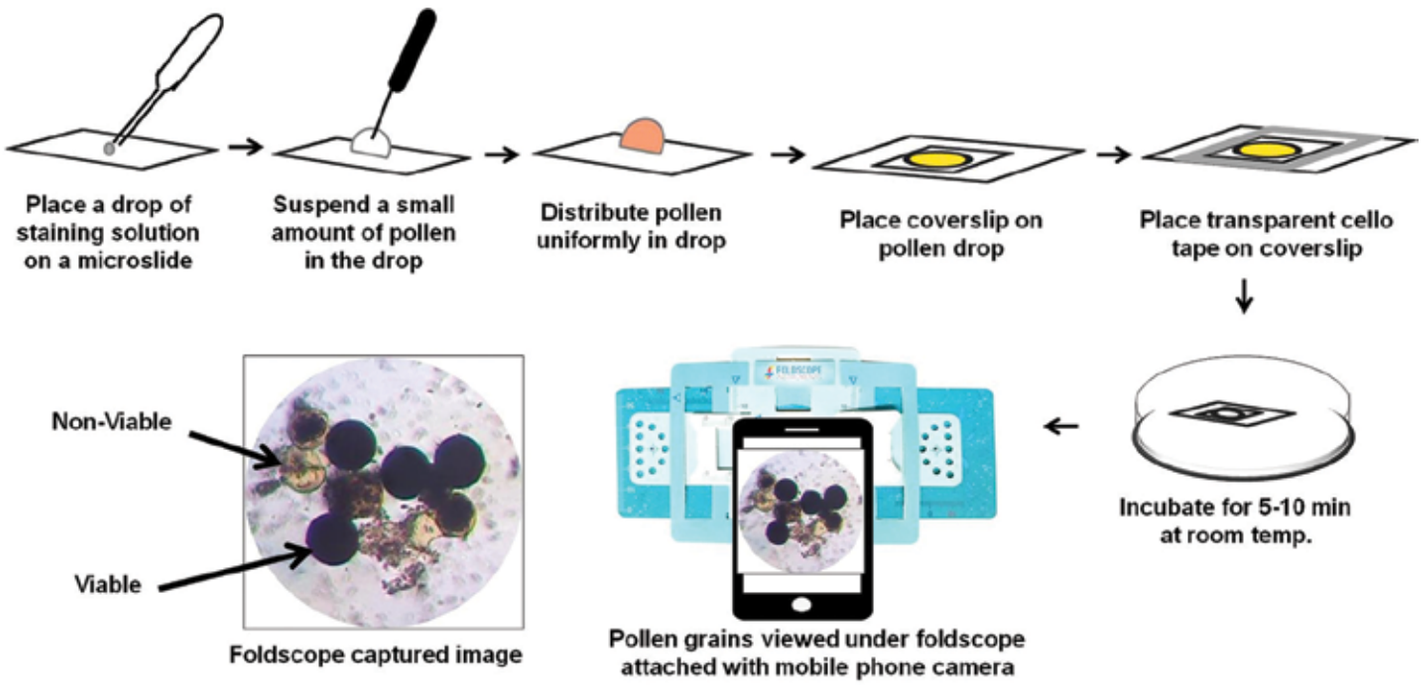


Fig.2. Stepwise generic protocol for pollen viability assessment using foldscope



man. It is assembled the same way as in origami art works which is user-friendly (only <10 minutes is enough to assemble foldscope), travel-friendly and small enough to fit pocket (size: 70x20x2 mm3; weight: 8 g; non-fragile). The magnification of the foldscope ranges from 140X to 2000X and 2 micron resolution. As there is no limit for the range of magnification we can get magnification at a cellular level and even more profound. For focusing the sample, there are two scales provided on the foldscope which can be moved to focus on a specific region of the sample. The application of this foldscope is limitless, and it can be applied for research as well as testing purpose in various fields. Foldscope can be attached to a smartphone with the help of magnet for the user to take pictures of the magnification. It is compact and light, especially when compared with conventional microscopes (Cybulski et al., 2014). Recently, the application of foldscope microscopy is becoming an established handy imaging technique in several fields' viz., plant science, pollen studies, insect taxonomy and identification, pathogen detection, antioxidant assays, medical field etc. (Table 1). With the objective of having a microscope for everyone, Department of Biotechnology (DBT), Government of India and Prakash Lab at Stanford University, USA signed an agreement to bring the foldscope to India to generate curiosity in science (Nischal, and Sharma, 2018). However, there is lack of information on how to use this novel tool in the field of plant genetic resources (PGR) management. Hence, in the present study, we reported applications of foldscope in different facets of PGR management viz., collection, conservation, characterization and evaluation of PGR, seed health testing for insects, pathogens and nematodes, seed biology studies and PGR education.

Methodology

Foldscope used in the current study was purchased online (Amazon) having magnification of 140X and assembled as per the guidelines given with foldscope (Fig. 3a).

Sample and slide preparation

Procedure for pollen viability assessment was discussed in detail from slide

Fig.3. Applicability of foldscope in different facets of plant genetic resources management. (a) Assembled folscope (b) Rice pollen viability using 1% potassium iodide (c) Cow pea pollen viability using 2% acetocarmine (d) Black gram pollen viability using 1% potassium iodide (e) Black gram pollen germination using Brewbaker and Kwack (BK) medium with 10% sucrose (f) Bhendi pollen germination using BK medium + 10% sucrose (g) Stem hairiness of cluster bean (h) Ovary of rice flower (i) Stigma of rice flower (j) Stigmatic surface of Alliums (k) Onion bulb cells (l) black mold on onion (m) Fusarium spores (n) hairiness on brinjal stem (o) Cross section view of brinjal stem.

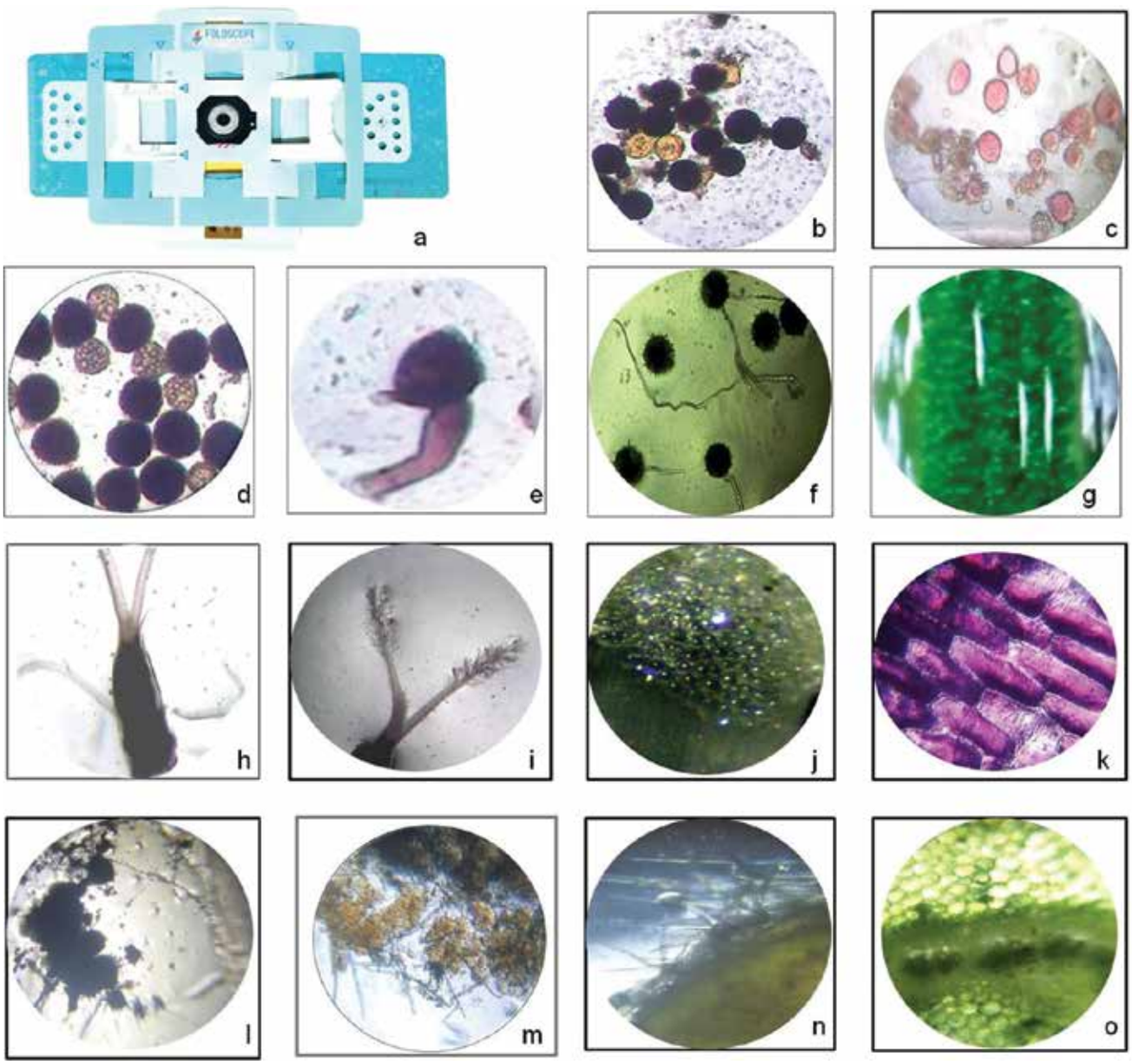


Table 1. Examples of wide range applicability of foldscope

Monitored superoxide production and cell death during pathogen infection in arabidopsis under different nitrogen regimes	Arora et al., 2020
Assessed pollen physiology, temporal variation in pollen viability of different soybean genotypes.	Pawar et al., 2020
Studied cervical cytology in humans	Naqvi et al., 2020
Observed isolated pathogens of Zingiber officinale	Abirami and Maghimaa, 2019
Anatomical microscopic characterization of botanicals having anti-malarial properties used by the tribal communities of Assam	Borah and Saikia, 2019
Observed root hairs of different rice varieties, rice lemma trichome, redgram pod trichomes, pollen fertility among the rice hybrids, brown spot of rice, Antracnose of greengram,	Diwan and Chikkanaragund, 2019
Observed stomata in ambadi, banana, barley, coconut and tradescantia, , pollens of Canna, Caesalpinia, Catharanthus, Hibiscus and Ixora, powdery mildew infested grapevine leaf and stem, fungal cultures such as *Colletotrichum gloeosporoides* and *Colletotrichum capsici*	Gurjar et al., 2019
Onsite and offsite identification and characterization of indigenous plant species with medicinal used in North East Region and at other locations.	Harshal et al., 2019
Recorded floral and faunal diversity in the Thar Desert of Rajasthan	Harwani et al., 2019
Studied morphology, histology, powder characteristic of fennel, ginger	Juvatkar et al., 2019
Micromorphological analysis viz., stomatal density, stomatal index, acicular trichome density, acicular trichome length, glandular trichome density, glandular trichome length, vein-islet density, veinlet termination number, leaf architecture, morphology of crystals, presence of the hypostomatous leaves of *Oxalis corniculata*	Mahipal et al., 2019
Studied on Onion cells (*Allium cepa*)	Prabhu and Rajasekar, 2019a
Identification of colour pigments in root vegetables - Carrot (*Daucus carota*) and Beetroot (*Beta vulgaris*) by foldscope	Prabhu and Rajasekar, 2019b
Examined agriculturally important microbes related to rice plants	Sabarinathan et al., 2019
Seed viability assessment of locally grown crop varieties like wheat, maize, Moong dal and Maa dal purchased from local market using tetrazolium test	Sharma and Nischal, 2019
Histochemcial localization of secondary metabolites in *Acacia nilotica, Albizia procera, Ailanthus excels, Caesalpina pulcherima, Crateva religeosa, Eucalyptus oblique, Pongamia pinnata, Prosophis juliflora, Terminalia arjuna and Vitex nagundo* in different plant stem tissue cells	Shekhaliya et al., 2019
Studied pollen morphology of *Callistemon citrinus, Crinum asiaticum, Helianthus annus, Hedychium spicatum, Hibiscus rosa sinensis, Hymenocallis speciosa, Zephyranthes candida*	Singh and Devi , 2019

Diagnosed the incidence of foliar fungal pathogens like *Cladosporium cladosporioides, Xylaria hypoxylon, Colletotrichum sp., Colletotrichum coffeanum, Rhizosphaera oudemansii, Alternaria alternata, Exobasidium vexans* associated with the leaf spot and leaf blight disease in the tea garden of Sikkim.	Wangdi et al., 2019
Food borne pathogens were viewed under foldscope	Banerjee, 2018
Studied physical properties like crystallanity of different grades of maize starch powder	Joshi et al., 2018
Identified pathogen causing early blight fungal disease (*Alternaria solani*) in tomato leaves and the images captured were classified using various machine learning algorithms.	Maheswari et al., 2018
Detected in-tissue antioxidant activity (glutathione, NADPH oxidase, SOD, POD, MDAR etc.) and secondary metabolites (lignin, lipid, cellulose and hemicelluloses in pollens and stomata of Lantana camara	Nischal and Sharma, 2018

preparation to image acquisition for better understanding of the foldscope operation. For pollen studies, fresh flowers were collected from the field and pollen grains were collected by gently tapping flowers on petriplate or aluminum foil. A drop of 1% potassium iodide was placed on microscopic slide, a small amount of pollen was suspended in the drop and distributed uniformly using needle. A drop with microscopic slide was gently covered with cover slip without any air bubbles and incubated for 5-10 min. After 5-10 min, a transparent cello tape was placed above the coverslip. The slide was inserted into the foldscope in such a way that sample side was close to lens of foldcope. LED light supplied with foldscope instruments was used as light source (Fig. 2).

Image acquisition using foldscope

The prepared slides were placed inside the foldscope and slides were focused by moving two scales in the foldscope. Once the slides were focused, each microscopic field view image was captured using mobile phone camera (Redmi Note 6 Pro) attached to foldscope using coupler (Fig. 2).

Applicability of foldscope in PGR management and education

Germplasm exploration and collection

Identification of germplasm of the target species during exploration is the first and foremost thing in the PGR management. In traditional taxonomy (alpha taxonomy), identification of species is based on morphological keys such as size, shape, colour, stem, leaves, roots and seed structures which can be seen with naked eye. But this method fails to distinct closely related species with unaided eyes and is not a reliable and accurate method of identification. Use of additional aids to observe things were started during the 16th century with the invention of lens and then with microscopes. Later, morphology-based taxonomy with the aid of microscopy techniques has been extensively used in modern taxonomy to study anatomy, phytochemistry, embryology, palynology, serology, genetics, molecular biology, ecology, cytotaxonomy, cytogenetics etc. to confirm identification especially of intraspecific taxa and know more about the species and its dynamic attitude. In recent years many new approaches viz., electron microscope, SEM, TEM, morphometric imaging technology etc. have been applied to the elucidation of problems in systematic botany. At present, though many advanced microscopes are available for plant taxonomic

studies, the applicability of those techniques are restricted to well established labs/organizations due to their high cost and maintenance. These heavy weighted microscopes cannot be used by the germplasm explorers because it is difficult to carry during collection trips. In contrary to the advanced techniques, foldscope can be used by the plant explorers, botanists, taxonomists during their expeditions to identify/ differentiate closely related species. Harsh et al. (2019) used foldscope for onsite and offsite identification and characterization of indigenous plant species with medicinal uses in North East Region and at other locations by microscopic observation of plant root, stem, leaves and other parts, texture, shape and morphology.

Seed Health Testing for Pest-Free Conservation

Seed health testing (SHT) is one of the most important procedures of seed processing for detection and identification of pests (fungi, bacteria, virus, insects, nematodes and weeds, etc.) associated with germplasm of different agri-horticultural crops. The seed-borne pests may result in germination loss, reduction in seed quality by discoloration and shriveling and development of plant disease. Infected seeds/germplasm also play a devastating role in spreading disease to new areas, distribution of pathogens, new strains or physiological races of pathogens. Therefore seed health testing has major application in making germplasm free from pest before their conservation in the genebanks and it is a mandatory activity before their conservation in the seed gene banks. Accurate identification is a prerequisite to plan the management of these pests before storage. Most of these are not visible through naked eyes, microscopic identification is required. Foldscope can ease the joint inspection of seeds during quarantine process of large number of imported germplasm. After identification by adopting different salvaging methods to make germplasm pest-free, the materials will be released for conservation in National Genebank under medium-term and long-term storage conditions.

Seed conservation

In genebanks, seeds of collected germplasm are conserved for long term storage, which necessitates accurate taxonomic identity of each germplasm. Biological status reflects in the PGR databases, and these databases are a gateway for researchers to access information of germplasm. There is a need for a handy and portable microscope to crosscheck the identity of a large number of accessions before conserving in the genebank. Foldscope can be a better tool for ensuring true identity using seed-based diagnostic traits. For examples, wild species of pulses can be distinguished by their hilum structure and aril development which is difficult to be seen by naked eyes. Before conservation of seeds in the genebanks, it is necessary to access viability, germination and purity. Sharma and Nischal (2019) used foldscope to check seed viability of wheat by tetrazolium test.

Pollen viability assessment

Pollen morphology plays a vital role in taxonomic and phylogenetic history of the vegetation. Pollen viability, germination and pollen tube growth are highly critical for reproductive success in plants and hence productivity of crop plants. These processes are often affected by drought and heat hence result in reduction in crop productivity. During germplasm characterization and evaluation, pollen viability assessment of diverse accessions including crop wild relatives (CWR) is necessary (i) to know the pollination percentage, crossability percentage, (ii) to know the effect of drought, salinity, heat, temperature on pollen viability.

Generally, freshly opened flowers collected from the field were carried to the lab to assess pollen viability, using a compound microscope. This method is tedious and difficult to assess pollen viability of a large number of germplasm at a time, which often results in missing flowering period to complete the task. In contrast, foldscope reduces the efforts, as pollen viability can be assessed in the field itself, which in turn

helps to evaluate large number of accessions in a day. Even uneducated field workers can be trained to handle foldscope. Pawar et al., (2020) assessed temporal variation in pollen viability of different soybean genotypes using foldscope. Singh and Devi (2019) studied pollen morphology of Callistemon citrinus, Crinum asiaticum, Helianthus annus, Hedychium spicatum, Hibiscus rosa sinensis, Hymenocallis speciosa, Zephyranthes candida, Gurjar et al., (2019) observed pollens of Canna, Caesalpinia, Catharanthus, Hibiscus and Ixora.

Pest and disease diagnosis

Foldscope can be used for on-site field identification of pests and diseases or the images of pests and diseases can be used to obtain management practices from the expertise. Wangadi et al., (2019) observed the incidence of foliar fungal pathogens with the leaf spot and leaf blight disease in the tea garden. Abirami and Maghimaa, (2019) isolated pathogens of Zingiber officinale and observed them using foldscope. Maheswari et al., (2018) identified pathogen causing early blight fungal disease (Alternaria solani) in tomato leaves and the images captured using foldscope were classified using various machine learning algorithms. Arora et al., (2020) monitored superoxide production and cell death during pathogen infection in Arabidopsis under different nitrogen regimes

Antioxidant assays evaluation in medicinal plants

Nischal and Sharma (2018) used foldscope to detect in-situ localisation of ROS and antioxidants (H2O2 content, O2- content, glutathione content, ascorbate content, Thioredoxin reductase activity, NADPH Oxidase activity, catalase activity, superoxide dismutase activity, peroxidase activity, monodehydroascorbate reductase activity) and histo-chemical detection of secondary metabolites (lignin detection, suberin detection, phenolics and tannins detection, lipids detection, cellulose or hemicellulose detection, cellulose or hemicellulose detection, suberin and cutin detection, callose detection) in pollen and stomata of Lantana camara. With these applications, foldscope can be used to histo-chemical evaluation of germplasm for secondary metabolites.

Conclusion

Application of this low-cost microscopy technology to a different domain of study would help early researchers to better understand the microscopic world around us including microorganisms and brings hands-on microscopy to the fields and further enhancing scientific temperament among the masses. Capturing images of prepared samples allow students to discuss what they observe, and scale bars can be added to further quantify visual observations.

The use of foldscope digital microscopes in PGR education increase learning productivity, learning efficiency, ease of communication and student self-confidence.

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Genetic purity and its importance

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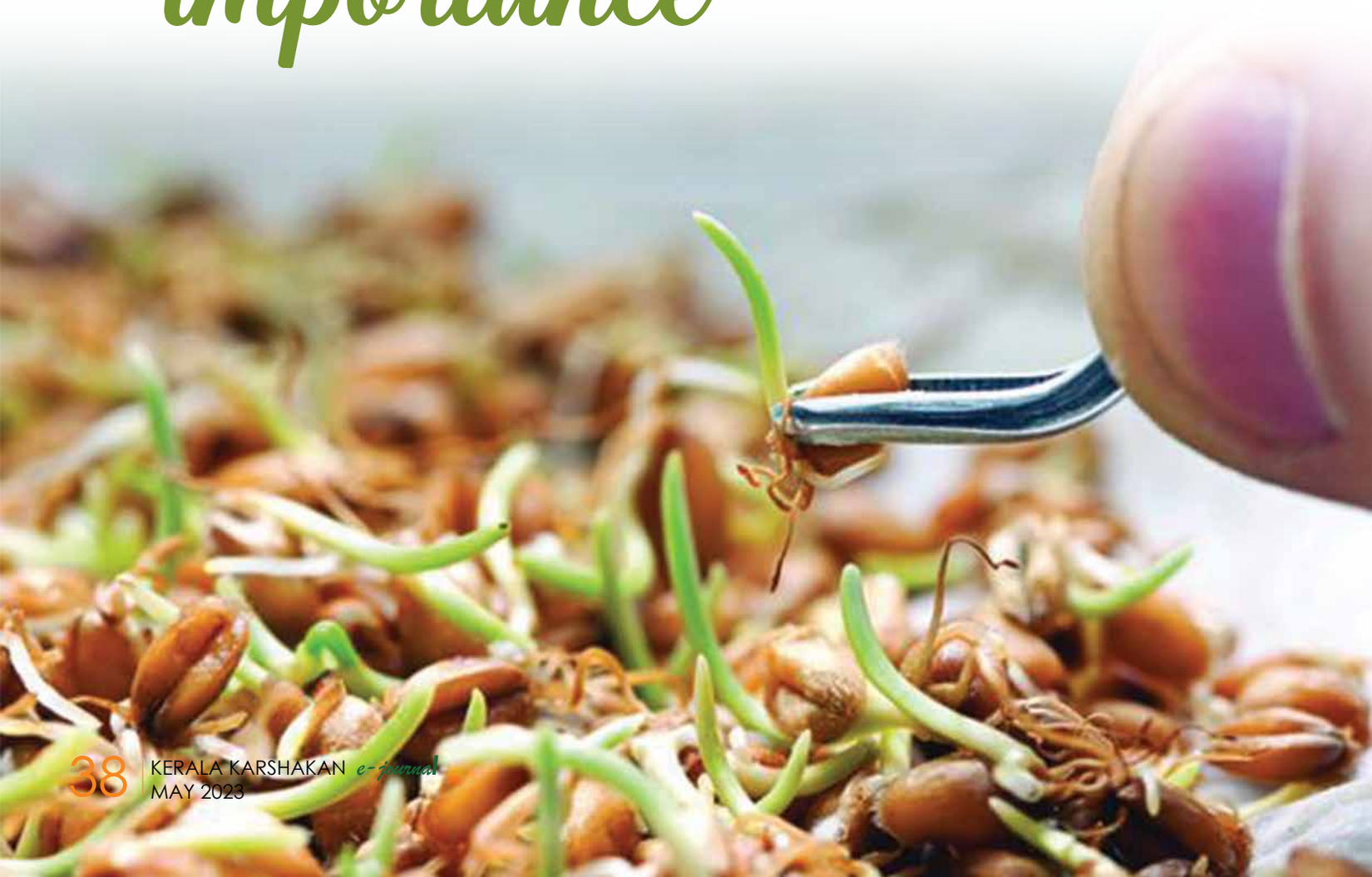
Genetic purity: Trueness to type, or the degree of contamination of seeds caused by undesired genetic varieties or species or in common terms we can say that the lot of seeds, tubers, plants or plant parts are homogeneous for inheritable characteristics as stated in the official description of the variety or strain represented.

Why genetic purity is important?

1. It help farmers to get expected yield, high yield or production without any lose.
2. It detect even minute genetic differences between cultivars (off types) which ultimately provides quality seed for entire nation through uproot sources.
3. It is helpful in plant variety protection, registration, certification, and patents or vice a-versa for existence of novelty among essentially derived varieties.
4. Ensure better agronomic performance and prevents admixture of seed at commercial level or farmer level.

Need for genetic purity: Through this we can increase crop production at national level where our country have been depending on agriculture.

- To increase farmers income and their standard of living.
- For plant breeders right and plant variety protection to make it strong.
- To test for new varieties with



DUS testing.

- Quality control of food grains for processing. Documentation of genetic resources.

According to Kadam (1942), the important factors of apparent and real deterioration of genetic purity are listed below:

1. Developmental variations: When a seed crop is grown in difficult environmental conditions such as soil fertility, different photoperiods or elevations for consecutive generations develops variations from main crop variety. Hence it is advisable to grow in their suitable agro climatic conditions.

2. Mechanical admixtures: it is major source of contamination of the variety during seed production. It may take place right from sowing to harvesting through different ways like by using same seed drill for sowing 2 or 3 varieties of a same kind, threshing floor for all varieties during seed processing and using same equipment for processing

A) Developmental variations

B) Mechanical admixtures

of more than 1 variety at a time. Drying 2 different varieties adjacent to each other.

3. Mutations: It is not of much importance as the occurrence of spontaneous mutations is very low and it cannot be avoided. Mutations such as 'fatuoid' in oats, 'rabbit ear'in peas should be roughed out.

4.Natural crossing: it is an important source of contamination in sexually propagated crops due to introgression of genes from unrelated genotypes. The extent of contamination depend upon the amount of natural cross fertilization, which is due to natural crossing with undesirable types, off types and diseased plants.

5. Minor genetic variation: it is not much important factor, however some minor genetic changes may occur during production cycle due to difference in environment. Due to this yield may be effected.

6. Selective influence of pest and disease: if proper protection measures has not taken against major pest and diseases, plant as well as seed get infected. In case of seed and soil borne diseases like downy mildew, ergot of jowar, smut of bajra and bunt of wheat, it is recommended not to use the seeds for commercial purpose once crop get infected. In case of foliar diseases the size of the seed gets affected due to poor supply of carbohydrates from infected photosynthetic tissue.

7. Techniques of the plant breeder: instability may occur in a variety due to genetic irregularities, if it is not properly assessed at the time of release. Premature release of variety, which has been breed for particular disease, leads to production of resistant and susceptible plants which may be important cause of deterioration. Other than these breakdown of male sterility, improper seed certification also causes deterioration of genetic purity. Of these, Mechanical admixtures, natural crossing and selective influence of pest and diseases are the most important reasons for genetic deterioration of varieties.

Hartman and Kestar (1968) suggested different ways for maintaining genetic purity are as follows:

Use of seed of an appropriate class and from approved sources is necessary for raising a seed crop. Classes of seeds like nuclear seeds, Breeder's seeds, foundation seeds and certified seeds given by AOSCA. Use of pure seeds for seed production in commercial scale will give ensured yields to farmers. Inspection of seed fields prior to planting to check whether land is previously grown with the same family crops or land infected with key pest or diseases. Field inspection and approval of crop at critical stages for verification of genetic purity, detection of mixtures, weeds and seed borne diseases and Roughing of seed fields prior to harvesting stage. Generally roughing is done at vegetative stage, during flowering and at harvesting time based on their leaf characters, infested with pest or infected with diseases which will pass on to seed.

A) Developmental variations
B) Mechanical admixtures
C) Mutation in rice
D) Selective influence of pest and disease

Sampling and sealing of cleaned lots of seeds after

C) Mutation in rice

harvesting and processing. Growing of samples with authentic stocks or grow out test for seed certification. Providing isolation to prevent cross fertilization or mechanical admixtures and to avoid undesirable pollination in cross pollinated crops. Grow in adopted areas only to avoid genetic shifts in variety which ultimately results in developmental variations. Periodic testing of varieties for genetic purity and viability of seeds for ensuring 100% germination. Adopting generation system, certification of seed crops to maintain genetic purity.

Methods to test genetic purity:

These are of two types
1.Conventional (morphological)
2. Modern methods
1. Some of the characters of morphological method are:

A) Seed- seed width, seed length, seed colour, cluster and size of seed, thickness of seed coat, hilum colour and hilum pigmentation.

B) Seedling – nodal pigmentation, hypocotyl pigmentation, seedling vigour index.

C) Plant characters: plant height, growth habit, stem pubescence, stem pigmentation,

D) Leaf characters: leaf length, lobbed leaf, pubescence.

E) Flower characters: days to 50% flowering, keel petal colour, pigmentation on standard petals, flower position.

F) Pod/ ear head characters: pod length, pod position, pod pubescence, pod constriction, pod shape, pod pigmentation.

G) Fruit characters: colour, shape, pedicel attachment, number of locules etc.

By morphological traits

D) Selective influence of pest and disease

alone we cannot go for genetic purity test as varieties of same kind are increasing day by day. It will be difficult to identify genetically pure lines and it is time requiring process. So along with morphological traits we go for modern methods.

2. Modern methods :

A) Rapid chemical: phenol, modified phenol, NAOH, KOH, peroxidase, GA tests.

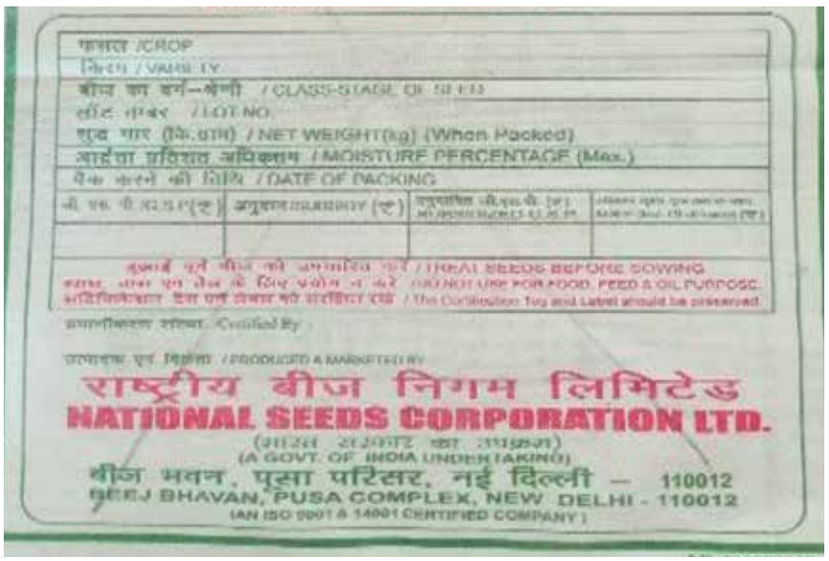
B) Biochemical: proteins, isoenzymes, profiling other seed constituents.

C) Molecular: By using molecular markers like RAPD, AFLP, SSR and RFLP etc.

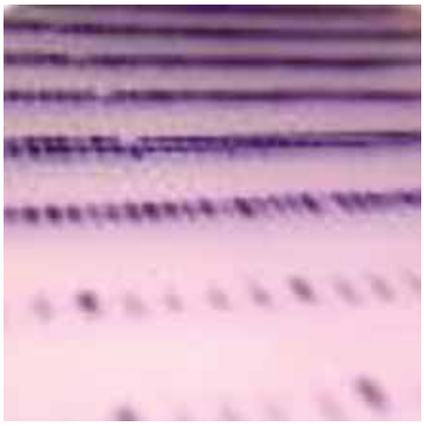
D) Mechanical: computerized seed imaging system.

Conclusion:

Lost in genetic purity majorly results in yield reduction. Example like in rice 1% impurity results in 1 quintal per ha reduction of yield. If we won't maintain genetic purity mainly for hybrids causes severe lose to farmers which indirectly damages our country's economy. So farmers has to be careful before purchasing seeds and seed



B) Seeds from approved source



A) Molecular method

B) Rapid chemical

C) Morphological method

A) Isolation distance

D) Inspection by officials

should be of appropriate class from approved source for raising a seed crop which are given by AOSCA, NSC etc.

Presently we are highly concentrating on high yielding hybrid varieties which easily lose genetic purity under irregular maintenance. Lose in genetic purity not only adversely affects the yield but also induces mutants, cause disturbance in ecological balance. Under proper maintenance like isolation to avoid natural crossing, roughing of seed fields, obtaining certified seeds only, conducting grow out tests for true to type forms, we can get expected yields or more.

References:

A) Molecular method

B) Rapid chemical

C) Morphological method

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C) Roughing of offtypes

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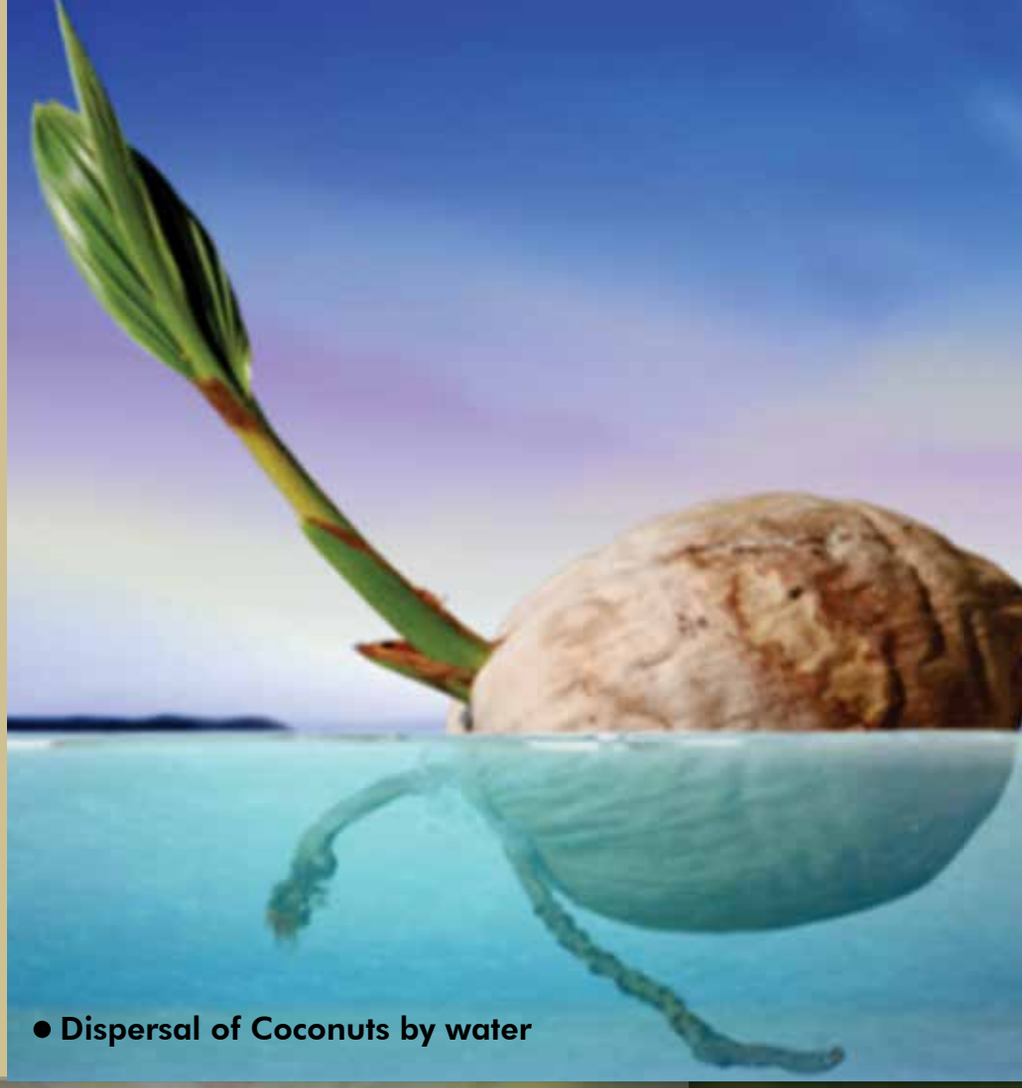

● **Dispersal of Coconuts by water**

SEED DISPERSAL MYSTERY OF SEED MOVEMENT

Introduction

Dispersal of seeds plays a fundamental role in the life history of plants, affecting their biology, ecology, dynamics and genetics. If plants grow too closely together, they have to compete for light, water and nutrients from the soil. Seed dispersal allows plants to spread out of a wide area and avoid competing with one another for the same resources. Seed dispersal is the mechanism of movement, spread or transfer of

● **Seed dispersal by wind of Dandelion plant**

● **Dispersal of seeds by animals**

seeds away from the parent plant. Plants have limited mobility and rely upon a variety of dispersal vectors to transport their seeds. Seed dispersal can be accomplished through both abiotic and biotic mechanisms. Abiotic dispersal involves wind and water; biotic dispersal involves animal agents, including insects, fish, reptiles, birds and mammals. Seeds can be dispersed away from the parent plant individually or collectively, as well as dispersed in both space and time.

Types of Seed Dispersal

1.Autochory (Self dispersal)
2.Allochory (Dispersal by vector)

1. Autochory: It is derived from the Italian word meaning self dispersal of seed. These plants generally disperse their seed without any help from an external vector, as a result this will limits its seed dispersal distance to 5-7m (according. to Granville). This can be further subdivided into barochory, ballochory, blastochory and herpochory.

a. Barochory: In this plant uses gravity for dispersal and it is a simple means of achieving seed dispersal. The effect of gravity on heavier fruits causes them to fall from the plant when ripe. This allows for later transmission by water or animal.

Example: apple, coconut, passion fruit and those with harder shells.

b. Ballochory: In this seed is forcefully ejected by explosive dehiscence of the fruit. Often the force that generates the explosion results from turgor pressure within the fruit or due to internal tensions within the fruit.

An exceptional example of ballochory is Hura crepitans- this plant is commonly called the dynamite tree due to the sound of the fruit exploding and it can throw the seed up to 100 meters. Witch hazel uses this by simply squeezing the seeds out at 28 mph.

Example: Arceuthobium spp., Cardamine hirsuta, Ecballium spp., Euphorbia heterophylla, Geranium spp., Impatiens spp., Sucrea spp., etc.

Ballochory can be further subdivided into Zooballochory (Impetus provide by animal), Anemoballochory (impetus provided by wind), Hydroballochory (impetus provided by water) and Autoballochory (Propulsion mechanisms based on sap pressure or drying)

c. Blastochory: In this stem of the plant crawls along the ground to deposit its seed far from the base of the parent plant.

● **Dispersal of seeds by explosion of broom plant**

Example: Arachis spp.

d. Herpochory: In this seed crawls by means of trichomes and changes in humidity.

2. Allochory: It refers to seed dispersal where a vector or secondary agent is used to disperse seeds. These vectors may include wind, water, animals or others.

a. Anemochory: It is one of the more primitive means of dispersal. Wind dispersal can take on one of two primary forms: seeds or fruits can float on the breeze or alternatively, they can flutter to the ground. Seeds which have pappus or hair like structures with light weight are easily carried away to different places by wind.

Example: *Papulus spp.*

- **Chamaechory:** Here propagules blown by wind across the ground surface possess morphological adaptation.
- **Meteochory:** Small seeds transported by air.
- **Boleochory:** Transportation started by wind, further dispersal assured by other mechanisms.

Example: Dandelions, Maples Seed dispersal by wind of Dandelion plant

Hydrochory: Plants that grow beside or in water often use to disperse their seeds in water. These seeds are water proof and can travel for longer distance, depending on the specific mode of water dispersal.

Example: Taxodium distichum

- **Nautochory:** Transport by movement in the sea.
- **Bythisochory:** Drifting in flowing water.
- **Ombrochory:** Transport via rain drops.

Example: Lotus, Water lilies, Mangrove trees and palm trees Dispersal of Coconuts by water

b. Zoochory: Dispersal of seeds by animals is called zoochory. Seeds can be transported on the outside of vertebrate animals and the process is known as epizoochory.

Plant species transported externally by animals can have a variety of adaptations for dispersal, including adhesive mucus and a variety of hooks, spines and barbs.

Example: Trifolium angustifolium, Eichhornia paniculata

Dispersal of seeds by animals

Seed dispersal via ingestion and defecation by different vertebrate animals are called endozoochory usually most tree species disperse through this seed dispersal mechanism.

Example: *Pinus spp., Prunus spp., Olea spp., Xanthium, Pomelo,* Guava etc.,

In some crop species like guava, cherry and citrus etc. Generally seeds survive the passage through the gut of animal and excreted. Meantime, the animal has likely moved somewhere and seeds have been dispersed far from the parent tree and ready to germinate which gives birth to a new plant. Other types of zoochory are Stomatochory (transport in the mouth), dysochory (transport

● Seed dispersal by birds

of accidentally ingested propagules), chinopterochory (Seeds dispersal by bats) Ornithochory (Seed dispersal by birds) Malacochory (Seeds dispersal by molluscus) and myrmecochory (Seed dispersal by ants best example is Elleborus spp.)

Seed dispersal by birds

c.Anthropochory: Dispersal of seeds by humans. It's most widespread and intense cases account for the planting of much of the land area on the planet, through agriculture.

Significance of seed dispersal

- The chances of seed survival are high because of less competition among the same species.
- The seeds can germinate when they get favourable conditions.
- The main advantage of seed dispersal is to protect themselves from predators.
- Seed dispersal prevents the overcrowding of plants in an area.
- Seed dispersal prevents the competition for light, water and soil nutrients among the same kind of plants.
- Plants can acquire new habitat.
- It helps in maintaining biodiversity.

Disadvantages of Seed dispersal

- In case of seeds dispersed by water, it will reduce the chance of survival for the seed as if it floats to a place without soil, it cannot germinate.
- In seed dispersal by animals, it does not provide dispersal agents with a nutritional or energetic "reward" that an animal will walk by and pick up seeds from the plant (Eugene, 1973).

Conclusion

Seed dispersal is the most important process for the regeneration of plant culture. It is an adaptation process found in all seed bearing plants that ensure the survival and germination of seeds. Seed dispersal is universally considered important for biodiversity conservation. Dependence on animal behavior for seed transport means that plants are susceptible to dispersal failure when their seed vectors disappear. (Mc Conkey et al., 2012).

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KAU ABI seeks innovative minds to catalyst their ideas to new venture creation

KAU RAFTAAR Agri Business Incubator through its incubation programmes promote innovation, Entrepreneurship and business creation in agriculture and allied sector and facilitate evolution of agri-startup ecosystem. KAU RABI envisages agribusiness incubation by helping creative minds to innovate and audaciously use technologies for venture creation in agriculture. KAU RABI has successfully incubated more than 169 entrepreneurs through its incubation programmes. KAU RABI is now launching its fifth Cohort of entrepreneurs under Agripreneurship Orientation Programme viz. 'KAU RAISE 2023'(Realising and Augmenting Innovations for Startup Enterprise) and Startup Incubation Programme viz. 'KAU PACE 2023'(Promotion of Agriculture through Commercialization and Entrepreneurship) supported by RKVY-RAFTAAR, Ministry of Agriculture and Farmers' Welfare, Govt of India. Applications are invited from Startups/ entrepreneurs who have innovative ideas and want to start agribusiness ventures.

The participants of Agripreneurship Orientation Programme ('KAU RAISE 2023') will be provided with two months' internship cum hands on training along with expert mentorship and assistance in development of ideas into prototypes. On successful completion of the programme, the trainees will have to undergo further screening at different levels. Selected candidates will be eligible to receive grant in aid limited to Rs.5 lakhs.

The agristartups which look forward to commercial launch of their prototype can apply for startup Incubation programme ('KAU PACE 2023') which includes mentoring on commercialization of existing prototype, technical and business support, and long-term incubation support. On successful completion of the programme, these startups will have to undergo further screening at different levels. Selected startups will be eligible to receive grant -in- aid limited to Rs.25 lakhs.

Applications for these programmes can be submitted online or by sending filled in application forms which can be downloaded from KAU web site, through e-mail, post or can fill Google form (visit: www.kau.in for details), from 01.05.2023, 10.00am to 29.05.2023, 4.00 pm. Applications received after this deadline will be considered invalid.

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Contact No. 8330801782/0487-2438332
E-mail: rabi@kau.in

COMPARISON OF SOIL FERTILITY STATUS OF PRE AND POST FLOOD SOILS OF SOUTH CENTRAL LATERITES (AEU 9) OF KERALA

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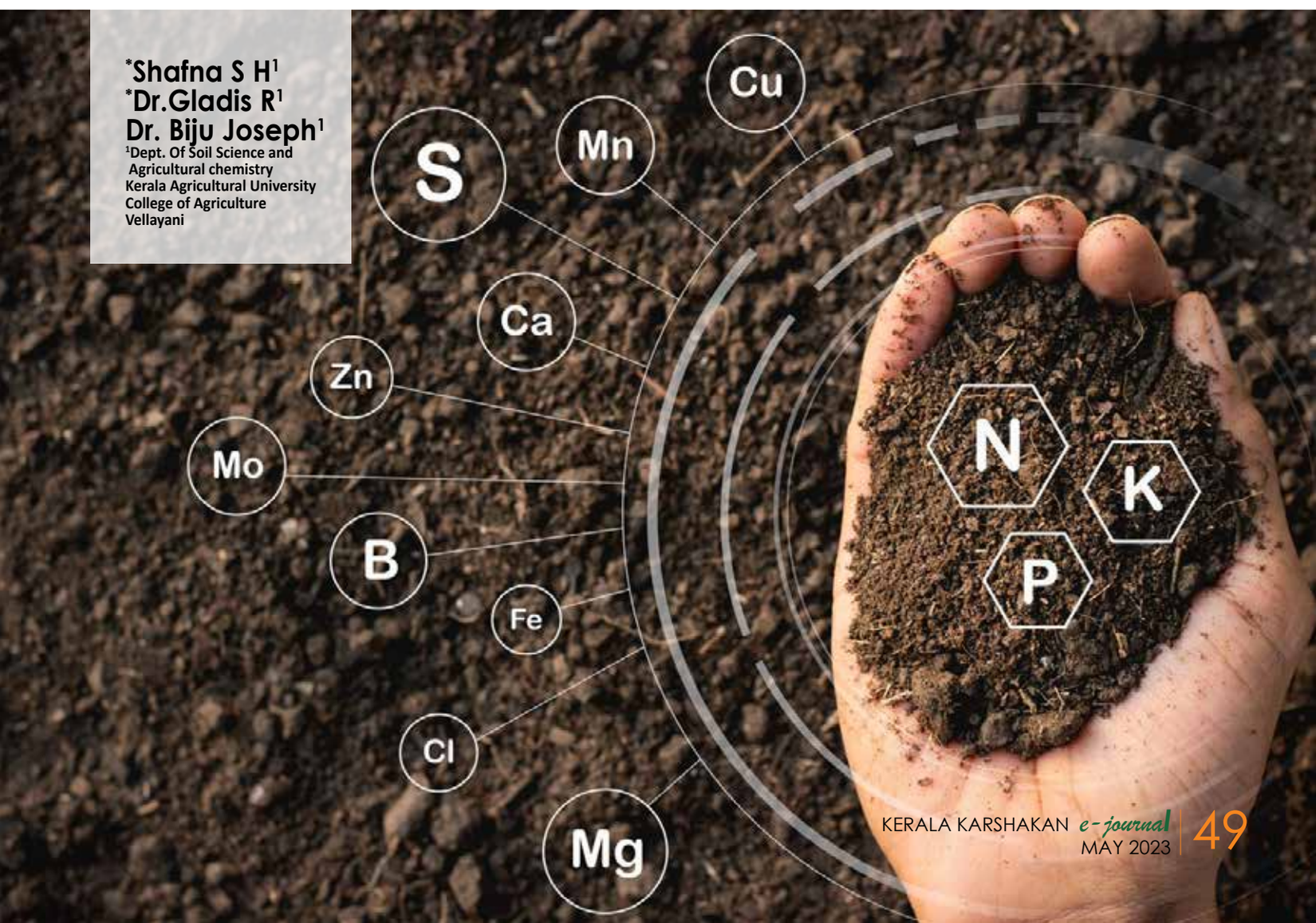
Soil is the most important natural resource which support productivity of any region. The agroecological unit 9 (south central laterites) in Pathanamthitta includes Mallappally, Koipram, Elanthoor, Parakkode, and Panthalam blocks and Adoor municipality. The soils of theSouth central laterites (AEU 9) exhibit some spatial variability in their properties. These soils are strongly acidic, gravelly, contains lateritic clay and underlined by plinthite. The overall nutrient status of Pathanamthitta soils are medium in content of organic carbon and available potassium, high content of available phosphorus, exchangeable calcium and sulphur, deficit levels of magnesium and boron and sufficiency with respect to iron,



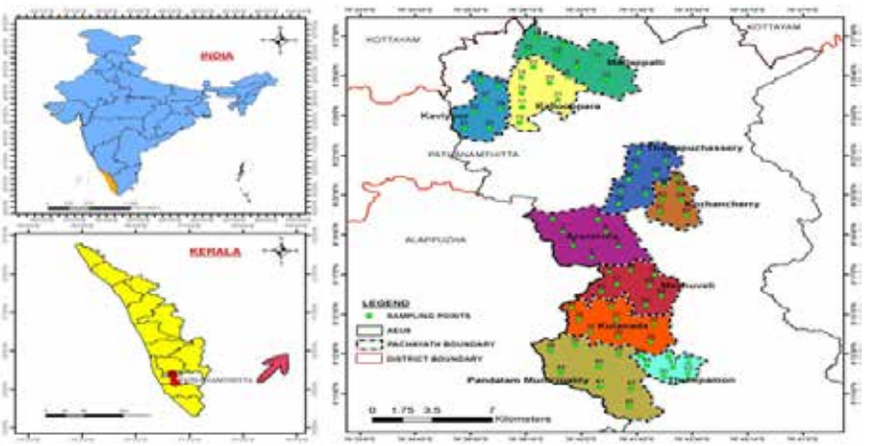


Fig.1. Location map of samples in AEU 9 of pathanamthitta district.

copper, manganese and zinc (Kerala State Planning Board, 2013). Major crops includes rubber, coconut, banana, tapioca, Paddy and vegetables such as amaranth, brinjal, bhindi, cowpea, cucumber, bottle gourd, snake gourd, ash gourd, chilli and tomato. Parts of Manimala, Pamba and Achan kovil river passes through AEU 9. The devastating flood heavily impacted the agricultural sector in the south central laterite area of Pathanamthitta district. Farmers should be made well aware about the changes that had occurred to the soil due to the flood and their management strategies for the effective implementation of post-flood management activities in agriculture sector. A detailed study on soil fertility of post-flood soils of various agro ecological units covering predominant cropping systems prevailing in those AEUs will help in formulating sustainable crop management strategies in these flood affected areas. Hence the present study has been undertaken to assess the soil fertility of post-flood soils of AEU 9 in Pathanamthitta district and to develop maps on soil characters using GIS techniques.

RESULT AND DISCUSSION

Large quantity of sediment deposition was observed in the flood affected area of AEU 9. The flood did not cause much alteration in the soil texture and the dominant textural class was loam.

Acidity falls into very strongly acidic, strongly acidic and moderately acidic categories after flood. Extremely acidic and slightly acidic categories vanished after flood. Most of the sample comes under strongly acidic category after flood (KSPB, 2013). Leaching of basic cations from the soil might have led to increased acidity and also the soil acidity lowered in regions where sediment deposits with high basic cations occurred. Similar results were reported by Ak povete et al., (2014).

Majority (57.3%) of the post flood soils are having medium organic carbon status followed by 38.7% soils with high status. Most of the sample (96 %) falls under medium and high status after flood. Percent of sample low in organic carbon status decreased after flood compared to pre flood soil. This can be due to the deposition of sediments rich in organic matter under the inflow of flood water and is in compliance with the findings of Kalshett yet al. (2012).

Available nitrogen was medium in 54.7 % samples and low in 46.7 % of the post flood soils. The reason for low available nitrogen observed in some panchayat seven though they showed medium to high organic carbon status may be attributed to low mineralization of organic matter as the soils are highly acidic. These results are in confirmation with those of Usha and Jose (1983) in laterite soils. The low availability of nitrogen in soil might also be due to leaching of nitrate nitrogen present in soil in the study area which received high amount of rain fall and also under the anaerobic

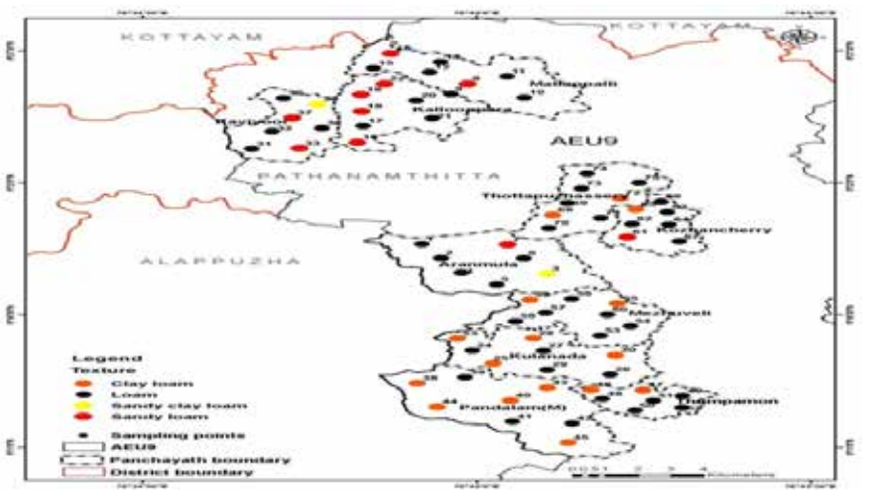


Fig 2. Spatial distribution of textural classes in the post-flood soils of AEU 9

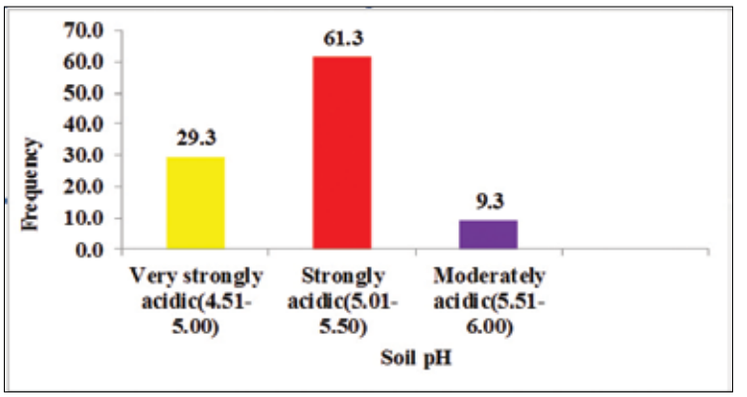


Fig 3: Frequency distribution of soil pH in post flood soils of AEU 9

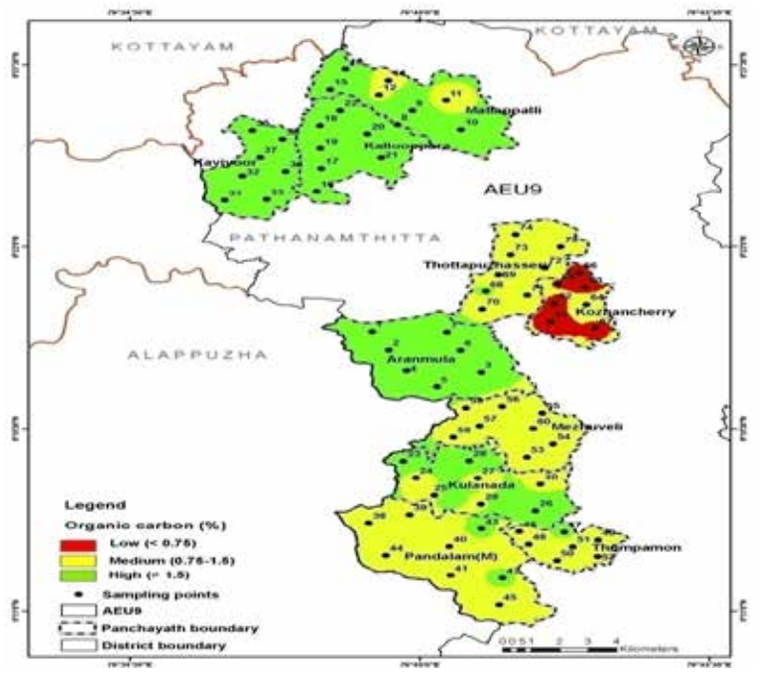


Fig 4: Spatial distribution of organic carbon in the post flood soils of AEU 9

conditions nitrogen loss would have occurred due to nitrate reduction and denitrification (Unger et al., 2009).

The phosphorus availability in these soils have reduced after flood which can be attributed to change in soil pH. The phosphorus availability is highly dependent on soil pH and Pavailability will be maximum at a pH of 6.5. Soils with medium status of available phosphorous increased in post-flood (37.3) compared to pre-flood (17%) where as high phosphorous soils decreased from 65% to 58.7%. Organic matter deposition in the soils may have also contributed to phosphate sorption and reduction in phosphorous availability. This agree with the findings of Sah and Mikkelsen (1989) who reported that flood induced P deficiency in soil is caused by high P sorptivity.

Available Kstatus in soil increased in post-flood soils compared to pre-flood soils. About 96.7 % samples became medium and high in K status earlier it was 92 %. Samples low in potassium status were reduced compare to pre flood soil. Similar findings were reported by Kalshettyet al .(2012). Low activity clays such as kaolinite and iron and aluminium oxides and hydroxides are predominant in laterite soils. These tropical soils can store K even without a large content of high activity clays and avoid leaching losses (Rosolem and Steiner, 2017). Which have contributed to increased availability of potassium.

Available Ca was deficient in 36 % of post-flood soils and adequate in 65.3 % but in pre flood soils 30% were deficient and 70% adequate in calcium. Decrease in calcium content after flood was due to the leaching of basic cations in flood water. These findings were in accordance with those reported by Leno et al. (2013) and Mengelet al. (2011).

There was a decline in available magnesium in soil due to the flood. Available magnesium was found to be deficient in 68 % of the post flood soils. Percent of sample deficient in Mg reduced (68%) compared to pre-flood soils (74 %). This reduction in Mg deficiency is due to the deposition of sediments and organic matter. Most of the samples are deficient in Mg in both pre and post flood conditions. Magnesium being a weak competitor of exchange sites with aluminium and calcium, appears to accumulate in soil solution and is subject to leaching loss in acid soils (Edmeadeset al.,1985)

Sulphur content increased in pre flood soil (adequate in 92%) compared to post flood soil (adequate in 76%).The higher levels of available sulphur might be due to the accumulation of organic matter and sediments in

Parameters	Fertility class	Percent of samples	
		Pre flood (KSPB, 2013)	Post flood
pH (%)	Extremely acidic	15	_
	Very strongly acidic	34	29.3
	Strongly acidic	24	61.3
	Moderately acidic	16	9.3
	Slightly acidic	11	-
OC (%)	Low	10	4
	Medium	42	57.3
	High	48	38.7
Available P (kg ha-1)	Low	18.0	5.3
	Medium	17.0	37.3
	High	65.0	58.7
Available K (kg ha-1)	Low	8	6.7
	Medium	39	50.7
	High	53	44
Available Ca (mg kg-1)	Deficient	30	36.0
	Sufficient	70	65.3
Available Mg (mg kg-1)	Deficient	74	68
	Sufficient	26	33.3
Available S (mg kg-1)	Deficient	24	9.3
	Adequate	76	92
Available B (mg kg-1)	Deficient	59	100.0
	Sufficient	41	--

Table 1. Comparison of parameters of pre and post-flood soils of AEU 9 of Pathanamthitta district

these soils. Available B became deficient in all the soils of AEU 9 after the flood earlier deficiency was 59 % (KSPB, 2013). This can be attributed to the higher mobility of boron in soils and also leaching losses which led to B deficiency in these soils. High intensity rainfall will lead to loss of soluble forms of boron by leaching (Mengelet al., 2011). Available iron content was adequate in all the soil samples. The sufficiency of available iron in the post flood soil might be due to the reason that insoluble form of Fe is reduced to more soluble form (Fe2+) under submerged condition (Fageriaet al., 2011). Presence of iron rich parent material and leaching of basic materials from the surface layers of the soils may also leads to the high available iron. Manganese content remained high in the study area in both pre and post flood period.

Deficiency of Zn increased after flood (33.3%) compare to pre flood condition (10 %) (KSPB, 2013). This deficiency may be due to leaching losses occurred during flood. Similar reduction in availability of Zn reported by Fageriaet al. (2011) in submerged soils.Available copper content became adequate in 100 % of samples which was deficient in 13 % samples of pre flood soil. This may be due to accumulation of organic matters and sediments after flood.

CONCLUSION

The results of the study revealed that the nutrient status were slightly altered in the soils of AEU 9 in Pathanamthitta district after the 2018 flood. Soil acidity increased in some areas due to the leaching of basic cations and erosion by flowing flood water. Organiccarbonand availableKwereincreased andavailableP slightly decreased after the floods and widespread deficiency of available nitrogen were observed. Deficiency of calcium and magnesium increases after flood. The entire study area showed deficiency of boron.

Here sult sout line the need for regular liming to control soil acidity and to alleviate Ca deficiency. The soils should be supplemented with Mg and B in addition to recommended dose of N, Pand K fertilizers.

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