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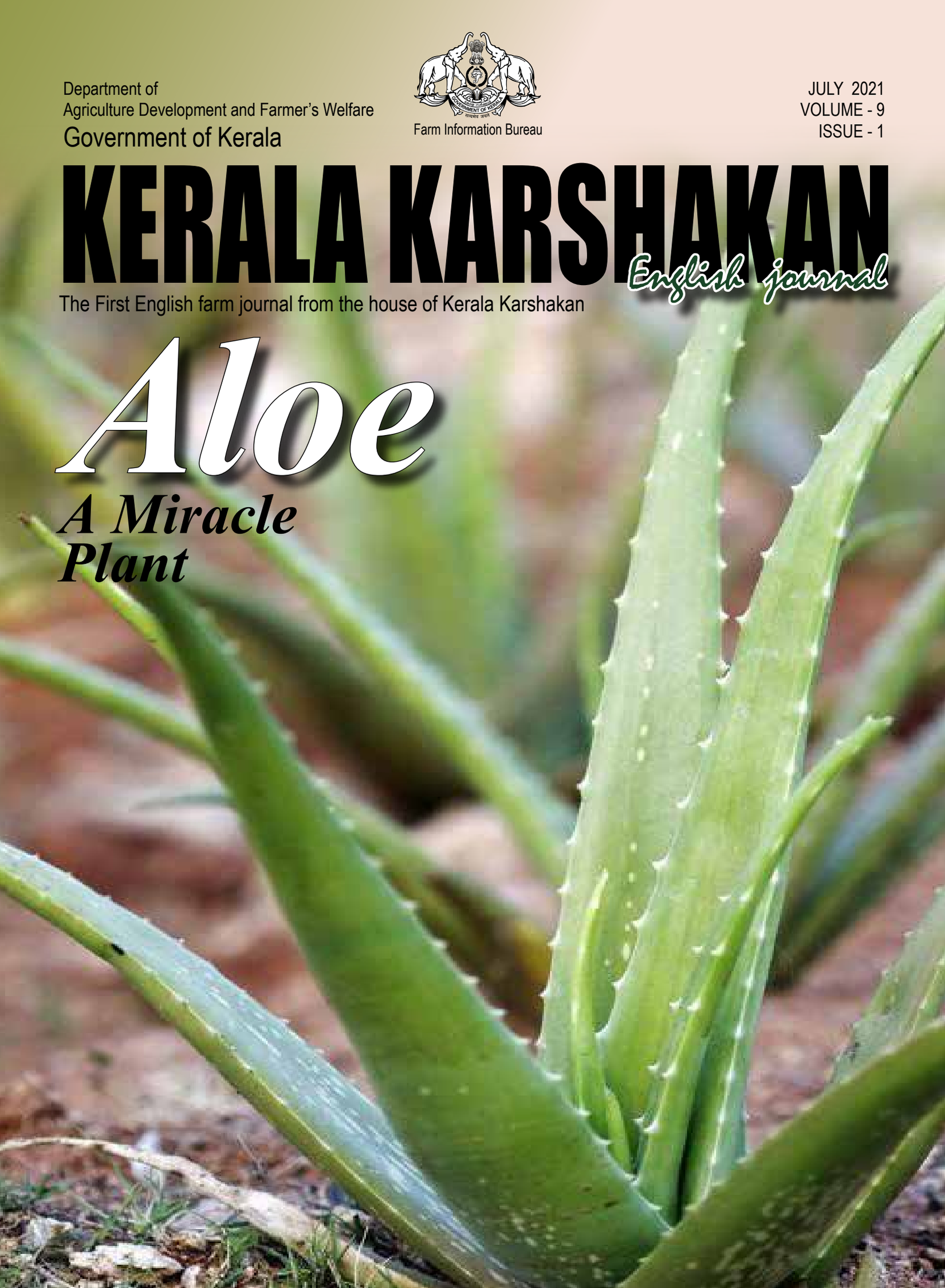
English journal

The First English farm journal from the house of Kerala Karshakan



Aloe

A Miracle Plant

INSIDE

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In the last issue, we discussed advances in plant breeding at the molecular level that allow us to develop improved crop varieties in a fraction of time, compared to classical breeding techniques. In summary, a rearrangement of A, T, G and C or the base pairs building blocks of DNA can alter the amino acids and hence the proteins they code for, ultimately changing the growth habit and traits of the given crop. An analogy can be drawn where changing certain alphabets in a word or sentence can alter the message conveyed.

Advances in genetic engineering have occurred at

Genetically Engineered Crops

a speed in which supporting disciplines of agriculture have not kept pace with. Therefore, it is imperative to implement this technology in a manner such that irreversible changes are not caused to cropping or ecosystems, and that benefits of GM crops far outweigh any risks associated with them. A review article in *Science* (December 2000) concluded that scientific information available was not adequate to draw conclusive deductions on GM crops' potential benefits or risks to the environment. In this issue, let us critically examine some of the benefits and risks related to GM crops in an objective manner.

Food Supply and Pesticide Usage

Transgenic crops can provide cheaper food by improving agricultural productivity. By utilizing this technology, crops that can tolerate adverse environmental conditions (drought, cold, soil salinity etc.), certain insect pests and plant diseases, can be developed. Such crops may also reduce the dependence on insecticides and fungicides. For example, Bt crops resist certain insect pests and can reduce the need for insecticides. Opponents of the technology argue that transgenic crops can increase our dependence on herbicides through the buildup of herbicide-resistant weed biotypes.

Nutrient levels

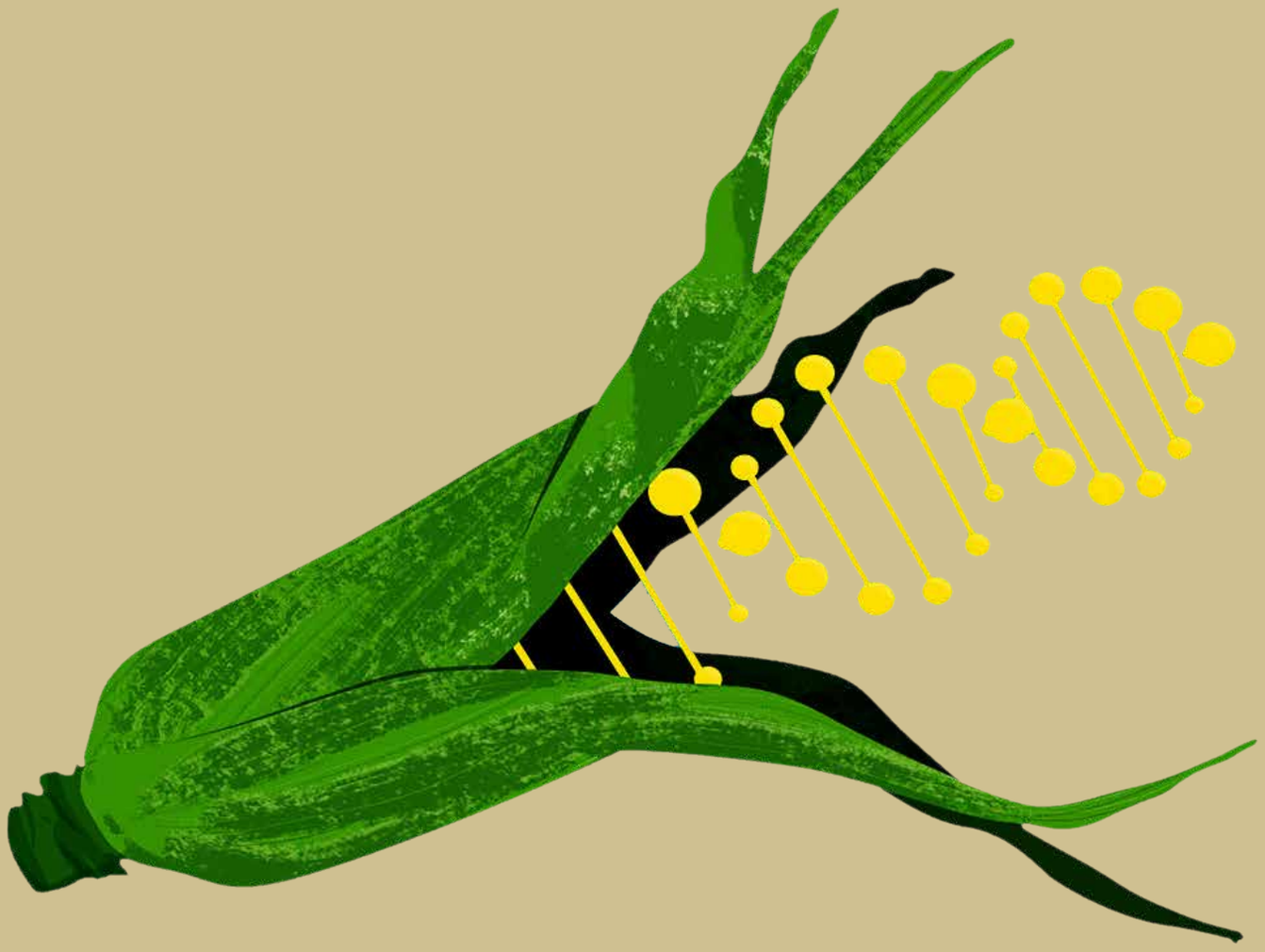
Certain transgenic crops (e.g., "golden rice" capable of synthesizing the precursor of Vitamin A) are capable of producing higher amounts of nutrients and vitamins, which could have a great impact on solving nutrition problems in heavily populated and underdeveloped countries.

Faster breeding

A definite benefit of transgenic crops is that they can be bred for desirable traits very precisely and much faster when compared to traditional method. A related disadvantage is that since the actual "breeding" in genetic engineering is carried out under laboratory or sterile conditions, the implications under field conditions may not be fully understood until a problem arises.

Ecosystem diversity

Large-scale



adoption of GM crops carries the risk of eroding the biodiversity of agroecosystems due to intensive management practices that encourage a monoculture. This in turn can affect ecosystem services provided by related beneficial organisms. A study published in Nature (1999) indicated that secretions from remains of Bt corn adversely affected certain other soilborne nontarget insect species. While herbicide-tolerant crops can provide farmers with cost-effective tools to manage weeds in no-till farming reducing soil erosion and nutrient losses, it involves total vegetation control, which can detrimentally affect an ecosystem's species biodiversity.

Crop diversity

Doubtlessly, GM crops have the capability to boost yield and profitability of farming. However, since genetic engineering focuses on crops with certain highly desirable traits, genetic diversity within the crop could be diminished. This can make crops more susceptible to natural calamities such as disease outbreaks. Although such problems have been encountered with hybrids generated by traditional breeding techniques, corporate interests have fueled the development of hybrids with "stacked-genes" where multiple desirable traits are bred into a single variety and farmers are forced to buy seed material at a premium price although some of the traits may not be used by the farmer. Similar profit-driven corporate strategies have led farmers become dependent on related products such as pesticides made by the same company. Such practices can ultimately reduce cropping diversity in intensive agricultural systems.

Herbicide-resistant weeds

In the United States, genetically modified crops simplified weed management for farmers for a period of roughly 10 years since their inception. Technology encouraged farmers to use cost-effective herbicides such as glyphosate repeatedly. Subsequently, a major indirect problem was the buildup of herbicide-resistant weeds. The evolution of weeds that are resistant to multiple modes of action have escalated the use of herbicides in major crops such as corn and soybean. Integrated pest management practices such as crop and herbicide rotation,

cover-crops, mechanical control etc., are now being adopted to address such challenges.

Allergies

There are claims that consuming transgenic foods has occasionally led to the development of allergies. A study reported in the New England Journal of Medicine in 1998 showed that people consuming transgenic soybean intended as animal feed, developed certain allergic reactions. Transgenic crops marketed for human consumption have not been linked directly to causing widespread allergies. Also, crops capable of causing fewer allergies are being developed using this technology.

Gene flow

In theory, the flow of transgenes into other organisms through pollution (termed "genetic pollution") can pose unknown risks to the ecosystem. Once these genes are released, it is difficult to recall them. However, limited instances of such genetic pollutions have occurred over the past 25 years to cause alarming problems. Long-term effects are unknown at this point. There are also claims that transgenic crops may lead to the release of resistant strains of microbes into the environment by plants. Proponents argue that such risks are comparable to similar releases from medical or veterinary practices.

Pharmaceuticals

Researchers are testing transgenic plants that are valuable to farmers and consumers. They are capable of producing vaccines, pharmaceutical and other materials used in the medical industry. However, the ability of crops to safely contain such products has been questioned. Several more arguments for and against the use of this technology are found in the media today. Most of them are subjective and speculative. This topic is a very complex one, the ramifications of which may involve many disciplines. Therefore, future research may provide answers to some of the uncertainties we face now.

Equipping farmers with appropriate technology to improve their productivity have always been a wise investment. One must also consider that changes are constantly occurring in the field of Agriculture to keep up with an increasing demand for food with fewer hands engaged in production. While we have cutting-edge technology at our disposal, wise use of the same will help the economy, farmers, consumer and the environment to achieve sustained benefits.

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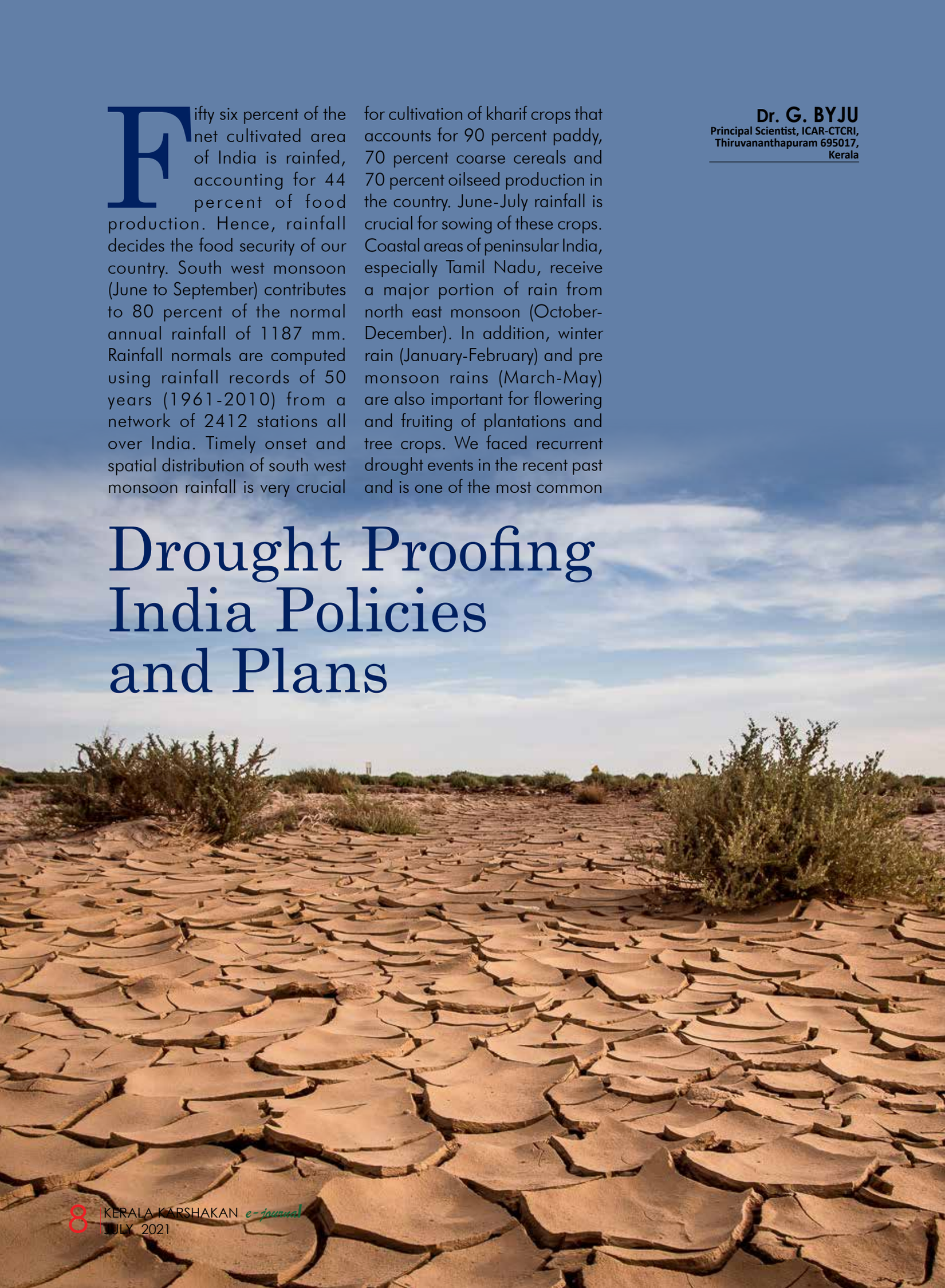
Drought Proofing India Policies and Plans

Fifty six percent of the net cultivated area of India is rainfed, accounting for 44 percent of food production. Hence, rainfall decides the food security of our country. South west monsoon (June to September) contributes to 80 percent of the normal annual rainfall of 1187 mm. Rainfall normals are computed using rainfall records of 50 years (1961-2010) from a network of 2412 stations all over India. Timely onset and spatial distribution of south west monsoon rainfall is very crucial for cultivation of kharif crops that accounts for 90 percent paddy, 70 percent coarse cereals and 70 percent oilseed production in the country. June-July rainfall is crucial for sowing of these crops. Coastal areas of peninsular India, especially Tamil Nadu, receive a major portion of rain from north east monsoon (October-December). In addition, winter rain (January-February) and pre monsoon rains (March-May) are also important for flowering and fruiting of plantations and tree crops. We faced recurrent drought events in the recent past and is one of the most common



and frequent natural disaster affecting Indian agriculture. During the past 74 years since independence, 16 years were declared drought years.

According to the Manual for Drought Management published in 2016 by Ministry of Agriculture & Farmers Welfare, Government of India, 68 per cent of cropped area in India are prone to drought, 35 percent of which receives rainfall between 750 and 1125 mm (drought prone) and 33 percent receives less than 750 mm (chronically drought prone). Unlike other natural calamities such as flood, earthquakes and cyclone, drought does not cause any loss of life or infrastructure and hence it often lacks visibility and timely media attention. But its impact on agriculture and other sectors of the economy are large.

While analyzing drought we need to consider many ground realities. Based on the rainfall data recorded at meteorological stations at district/tehsil/village level, meteorological drought is declared in the administrative units when the rainfall deficiency is more than 10%. Hydrological drought is the situation of inadequate ground water due to prolonged meteorological drought while agricultural drought occurs when insufficient soil moisture leads to crop losses. Normally meteorological drought leads to agricultural and then to hydrological drought. But there are situations where there is no meteorological drought as the total rainfall may be within normal range, but its uneven distribution may cause depletion of soil moisture or groundwater or less storage in reservoir. Such complex ground realities need attention of the governments while taking decisions. Due to these issues, from 2015 onwards, IMD changed the nomenclature of drought. It is now replaced with 'deficient year' and severe drought year with 'large deficient year'. Now it is left to the state governments to declare a year as drought year based on rainfall alone or combined with other parameters. It is noteworthy that the different states in India have different definitions of drought and methods of crop loss estimation. Our country needs a consensus for a single definition and loss estimation method for a uniform drought management policy. The new drought declaration guidelines of 2016 was framed to deal with such ambiguities and to avoid the subjective and flexible nature that existed. There is no uniformity in drought declaration parameters and this seriously affected relief measures. The Supreme Court of India urged the government of India to adopt a new system for drought declaration and the Union Ministry of Agriculture and Farmers Welfare introduced the Manual for Drought Management, 2016 which superseded the 2009 manual.

In order to develop a monitoring matrix for drought, five categories of indices are recommended. They are rainfall, vegetation, water, crop and others. The drought monitoring cell (DMC) in the states will monitor data regularly on various parameters for enabling estimations of rainfall deviation, dry spell, standardized precipitation index (SPI), vegetation condition index (VCI), area under sowing, percent available soil moisture (PASM), moisture adequacy index (MAI), reservoir storage index (RSI), groundwater drought index and stream-flow drought index (SFDI). Based on the data generated, three steps are used for the determination of drought.

First step is the examination of mandatory indicators namely rainfall deviation, or SPI or dry spell as per a matrix suggested in the manual (trigger 1). Inadequate rainfall leads to the examination of impact indicators (trigger 2) like availability of water for crops, soil and at ground level reducing the crop sown area. Here remote sensing and geographical information system (GIS) have great roles to play to assess the crop condition, soil moisture and groundwater level. The indicators for measuring the impact are VCI, the area under sowing, PASM and RSI. In the event that a trigger is set off, states will conduct sample survey for ground truthing for making a final determination of drought. This field verification exercise will be the final basis for judging the intensity of drought as 'severe' or 'moderate'. Unusual outmigration of labour in search of employment, fodder availability and its prices, supply of food grains, scarcity of drinking water supply for human and livestock, and current wages for both agricultural and non-agricultural sector may be used as supportive parameters for drought declaration. The kharif drought should be declared by

30 October and rabi drought by 31 March every year.

Now we have only two categories of drought, moderate or severe. If a moderate drought occurs, the state government is responsible for managing it with the State Disaster Relief Fund (SDRF) or by utilizing its own resources. This is one of the major deviations from the earlier provisions where even in the case of moderate drought, the central government provided funds to States. In case of severe drought, the States may approach the Central government for additional funds. The State government can submit a memorandum for assistance from National Disaster Response Fund (NDRF). It is now very clear that managing drought is the sole responsibility of state governments.

Once drought is declared, government will have to initiate relief and response measures. For this, we have to consult the Crisis Management Plan (CMP) for drought, which is being prepared by the Ministry of Agriculture and Farmers Welfare, before each kharif season. This is a ready reckoner for drought preparedness, drought reporting and drought responses. If a particular district is declared drought-hit, we have to consult the District Agriculture Contingency Plan (DACP) for the district (https://farmer.gov.in/ContingencyPlan.aspx). Such plans are prepared by CRIDA, Hyderabad for 614 districts and is available in the above website.

The drought management policy of the Government of India aims to manage drought at two stages. First is the mitigation and prevention measures such

as linking of rivers, canals, expanding area under irrigation and watershed development at the pre-drought stage. Drought mitigation measures are aimed to reduce soil erosion, augment soil moisture, restrict surface runoff of rainwater and to improve water use efficiency.

Water harvesting and conservation is an important aspect which include artificial recharge of ground water and traditional methods such as contour bunding, contour trenching, contour cultivation, bench terracing, graded bunding, gully plugging, check dams, gabion structure, stream bank protection, farm ponds, percolation tanks, anicuts, sub-surface barriers, injection wells, dug well recharge, village pond/tank, tankas/kunds/ kundis, khadin, vav/vavdi/baoli, hill slope collection, spring water harvesting and rooftop water harvesting. Water saving technologies include drip and sprinkler irrigation systems, improved water saving farm practices such as increased use of organic manure, mulching, crop rotation and use of biocontrol agents.

The post-drought policies are mostly financial assistance to drought affected farmers. In our country, the post-drought relief measures outweigh mitigation strategies. For effective implementation of the contingency plan, the practices which to be compulsorily taken are: land treatment (sowing across slope, ridge and furrow system, compartmental bunding, broad bed and furrow system, raised bed and sunken system, conservation tillage), harvesting and efficient use of rainwater (rainwater harvesting structures, farm ponds, percolation tanks, micro irrigation systems), cropping systems with suitable crops and varieties (seed bank, fodder bank, seed treatment, intercropping, agroforestry, conservation agriculture), need based nutrient management (nutrient banks, site specific nutrient management, foliar nutrition, organic recycling, tank silt application), farm mechanization (suitable implements, labour sharing mechanization, custom hiring centres) and fodder systems (silage, household/community systems, fodder systems).

Water resources management is another important aspect of drought relief. Unlike paddy and sugarcane, which are water-intensive crops, choose alternate crops such as maize, pulses, groundnut, sunflower, soybean, fodder, cassava and millets. Promote crop diversification of mixed/intercropping of main crop with drought tolerant companion crops, thinning of plant population, weed management, mulching for soil moisture conservation and protective irrigation.

Though the new drought management policy made many improvements over the previous system, the system became more complicated and there are many criticisms too. For example, drought is confirmed when the percent available soil moisture is less than 25 percent of plant available water (field capacity – permanent wilting point). But this varies from crop to crop as well as for different soil types. The new guidelines also stipulate more than three weeks of dry spell coupled with more than 50 percent rainfall deficiency to declare drought.

Moreover, area under sowing must be less than 33.3 percent in kharif and below 50 percent in rabi season than the normal area sown to declare a district/block/panchayat as drought affected. In practice, many farmers sow the crops in anticipation of a good rainfall and hence this criteria may not be fulfilled by many places even though they are severely drought-hit.

Since the frequency of drought is increasing over the years, we need to develop a comprehensive drought management policy incorporating drought risk financing, household's risk management strategies, climate change adaptation practices, preparedness and mitigation and drought-induced migration. Farmers from drought risk regions may be encouraged to undertake crop insurance. In contrast to other natural hazards, it is difficult to determine the beginning and end of a drought episode because of the slow, 'creepy' onset, silent spread and gradual withdrawal. Hence drought monitoring and management require a strong institutional setup in each state to study drought episode and related indicators such as soil moisture, crop sown and crop lost; as drought management is the responsibility of the state government.

The birth of a gem

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Pearl' as the word suggests is a valuable glistening object produced within soft tissues of a living shelled mollusk. In this arena of sustainable farming, pearl culture is an adoptable option as it is an eco-friendly and profitable venture. Also it

paves way for unemployed youth for establishing an enterprise. This also fetches higher price ranging from Rs 360 to Rs 1800 depending on the quality and size of the pearl. Naturally they are seen in certain oysters, mussels or clam, which is produced as a result of an irritant entering into their body. As a defensive mechanism these organisms secrete fluids to coat the irritant. After several coatings a lustrous pearl is formed.

'All you need is an investment in time', this is what someone would say about pearl culture. Fresh water pearl culture takes around 6 to 12 months for development of pearl depending on the size and number of nuclei implanted. In India the common species under freshwater environment are *Lamellidens marginalis* and *L. corrianus*. The basic steps in pearl farming includes collection of mussels, pre-operative conditioning, implantation of nuclei, pond culture of implanted nuclei and harvest of mussels and pearls.

Healthy mussels are collected from freshwater bodies. Now a days mussels are available in the market also. Usually mussels over 8cm in anterior posterior length would be preferred for pearl culture. Pre-operative conditioning is done to ease the handling process during implantation of nuclei. Here, collected mussels are kept in a crowed condition under captivity for 2 to 3 days with aged tap water at a soaking density of 1 mussel/ L. During the process of implantation, the beads or nuclei are placed in desired location either in mussel cavity or in the mantle tissue. This is a crucial process as care must be taken not to cause injury to the mussel as it may lead to its death.

During post-operative care of mussel, the implanted ones are kept in nylon bags for 10 days with antibiotic treatment and supply of natural food. Then these are stocked in the ponds.

The mussels kept in the nylon bags @ 2 mussels per bag are hung from bamboo or PVC pipes and placed in ponds at a depth of 1m. The ponds are to be fertilized with organic and inorganic fertilizers periodically. At the end of the culture period pearls are harvested. The mussels are opened one by one and pearls are cut out of the shell valve. The success rate is about 60 to 70 % of the mussels implanted.

As mentioned pearl culture requires technical know-how for implantation and care of mussels. There are various firms and government institutions providing training for pearl culture. Mr. Mathachan, a farmer from Kasaragod is popular for cultivation of pearls in bucket and had gained wide popularity in this field. Allegedly, innovative ideas are always appreciated. Pearl culture will be a profitable venture for those with some passion, interest and innovativeness.

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Chemical Fertilization to Green Manuring: "Moving towards Sustained Production"

Introduction

Imbalanced use of chemical fertilizers to soil and crops, reduce soil fertility, increase environmental pollution and decrease crop productivity. Managing soil health and crop productivity on sustainable basis is a vital challenge for the growers, especially in the situation, when crop production resources are getting costly day by day. Such conditions need utilization of low cost plant based nutrient sources like green manure crops. Green manuring is the practice of incorporating green manure crops into soil through ploughing, while they are green or soon after they start flowering. Green manuring maintains and improves soil health through addition of organic matter, minimize nutrient

Figure1. Sesbania aculeata green manure crop (Source–Yadav et al., 2017)

fixation loss, produces huge mass of humus and helps in reducing leaching losses of soil nutrients. Green manuring practice not only improve composition and nutrient balance of soil, but also provides a basis for a more environment friendly approach to modern farming. This article provides knowledge about cultivation practices of some important green manure crops and the benefits of green manuring practices on soil health.

Green manure crops:

Green manure crops are those, that are grown either in-situ or ex-situ and to be turned in to the soil to improve physical, chemical and biological properties of soil (FAO, 2011).

There are two types of green manuring:

1. In-situ green manuring: When green manure crops are grown in the field itself either as a pure crop or as intercrop with the main crop and buried in the same field, it is known as in-situ green manuring e.g. sunhemp, dhaincha, pillipesara, shervi, urd, mung, cowpea, berseem, senji, etc.

2. Ex-situ green manuring- It refers to turning of green leaves and tender green twigs of shrubs and trees into the soil, collected from bunds, waste lands and nearby forest area e.g. glyricidia, wild dhaincha, karanj etc. Potential green manure crops

***1. Sesbania aculeata* (Dhaincha)**

Dhaincha crop originated in Africa. It is one of the most preferable green manure crops among the farmers. It is a quick growing succulent crop, which can be incorporated at about 6 to 8 weeks after sowing. This crop adapts to varying conditions of soil and climate and can be successfully grown even under drought, water logging and salinity situations. Recommended seed rate for sowing of *Sesbania aculeata* is about 40-50 kg per hectare. The green biomass yield of dhaincha is about 20-30 t/ha. Dhaincha can fix about 96-135 kg nitrogen per hectare through biological nitrogen fixation.

***2. Sesbania rostrata* (Sesbania)**

Sesbania rostrata green manure crop has nodules both on the stem and root. It thrives well under waterlogged condition. The normal seed rate for sowing is about 30-40 kg per ha. It can produce about 15-20 t/ha fresh matter. *Sesbania rostrata* fixes about 80-110 kg biological nitrogen per hectare within a period of 7 to 8 weeks. Sesbania crop has good potential for incorporation in alley-cropping system. Farmers also plant *Sesbania rostrata* on field bunds. Pruning of Sesbania crop grown on bunds would be a source of readily available green manure.

***3. Crotalaria juncea* (Sunhemp)**

Sunhemp crop has originated from South Asia (Bangladesh, Bhutan and India). Sunhemp as a green manure crop is generally

grown during rainy season. Fast growth habit of sunhemp makes it ideally suited for planting in late summer. Sunhemp is normally incorporated in soil at 30-45 days of crop age. The normal seed rate is about 35 kg/ha. Sunhemp crop can fix about 95-100 kg atmospheric nitrogen per hectare. It is very high yielding and generally drought resistant.

***4. Leucaena leucocephala* (Subabul)**

Leucaena leucocephala is native to Central America. This multipurpose tree is used for fuel wood, lumber, animal fodder and green manure. It is a promising forage tree crop, the leaves of which contain about 3-4% N. *Leucaena* tree fixes about 260-320 kg N/ha per year. The incorporated leaves of Leucaena decompose quickly, providing a rapid influx of nutrients. Other important green manure crops for improving soil fertility and crop productivity are *Vigna unguiculata* (cow pea), *Vigna radiata* (mung bean), *Vigna umbellata* (rice bean), etc.

Incorporation techniques of green manure crops

Effective incorporation of the green manure crop is as much important as the growing of the crop. Degradation of the green manure crops in the field should be quickly and this requires good moisture and mixing with adequate aeration in the soil. It is also important that the green manure crops should be incorporated at succulent stage (almost at flowering) and not become too mature and woody. In heavy soils the green manure crops should not be incorporated too deep as it can slow down or prevent the decomposition.

Benefits of green manuring in crop production

1. Effect on soil properties

Adoption of green manure crops add soil organic matter through biomass decomposition. Increased organic matter in soil as a result of incorporation of green manure, improves soil

Table1. Biological nitrogen fixation of in-situ and ex-situ green manure crops

Green manure crops	Biological nitrogen fixation (kg/ha)	References
In-situ green manuring crops		
Sesbania aculeata (Dhaincha)	96-135	(Masood and Bano, 2016)
Sesbania rostrata (Sesbania)	83-109	(Masood and Bano, 2016)
Crotalaria juncea (Sunhemp)	95-100	(Mendonça et al., 2017)
Vigna unguiculata (Cow pea)	60-65	(Keston et al., 2017)
Vigna radiata (Mung bean)	35-50	(Hayat et el.,2008)
Ex-situ green manuring crops		
Leucaena leucocephala (Subabul)	260-320	(Rajendren and Mohan,2014)
Pongamia glabra (Karanj)	200-210	(Rajendren and Mohan, 2014)
Gliricidia sepium (Gliricidia)	105-110	(Mendonça et al., 2017)

Table 2. Nutrient compositions of green manure crops (Source-Sangma, 2017)

Crop	Nutrient content (%) on dry weightbasis		
	N	P	K
Green manure crops			
Sesbania aculeata	3.3	0.7	1.3
Crotalaria juncea	2.6	0.6	2.0
Sesbania speciosa	2.7	0.5	2.2
Tephrosia purpurea	2.4	0.3	0.8
Green leaf manure crops			
Pongamia glabra	3.2	0.3	1.3
Glyricidea maculeata	2.9	0.5	2.8
Azadirachta indica	2.8	0.3	0.4

physical properties by increasing the distribution and stability of soil aggregates and decreasing soil bulk density (Yadav et al., 2017). Soil aggregation may reduce soil bulk density and increase soil porosity with greater water retention capacities. Vegetative cover of green manure increase infiltration rate and moisture retention capacity of the soil.

2. Protection from soil erosion

Conventional tillage system offers dominance of bare soils in which intensive and direct fall of raindrops breaks soil aggregates and create obstruction to the soil pores. This causes the sealing of the soil surface and reduces infiltration which leads to soil erosion.

Green manure crops protect soil from soil erosion by preventing the direct impact of raindrops on and reducing the velocity of surface runoff by acting as barrier for water flow. Furthermore, green manure crop cover also reduces the loss of soil nutrients and organic matter through soil erosion.

3. Biological nitrogen fixation and nutrient addition (Table 1).

Green manure crops add large quantities of nitrogen to the soil through biological nitrogen fixation in the nodules, located on their roots or stem. The amount of nitrogen fixation is depending on species of leguminous green manure crops Beside a huge amount of biological nitrogen, several essential plant nutrients are also added to soil. The nutrient leaf manure crops are given below:

4. Effect on Weeds

Growing of green manure crops offer saving of labour, reduce the use of herbicides thus lowering production costs and promote ecological farming practices. Green manure crops suppress the weed growth at early stage and cut down the amount of water, light and nutrients resource used by weed population.

5. Increase crop productivity

Cultivation of appropriate green manure crops and their efficient incorporation, increase crop production and also cut down cost of cultivation through saving

Figure 2 Sunhemp green manure crop (Source- https://www.southernexposure.com/products/sunn-hemp-cover-crop/)

of resources, mainly the chemical fertilizers. The amazing results from green manuring practices could be seen, when adopted on a long term basis as a soil management tool.

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Snails & Slugs

An Emerging pest on crops

Introduction

Snails and slugs (gastropods) are most destructive pests of garden land crops and landscapes. They belong to a large taxonomic class of invertebrates coming under phylum Mollusca and class Gastropoda. The word Gastropod derived from Greek language, "gastro" means stomach and "podos" means foot. All the members of this class are commonly named as "snail", but include only those species having external big sized shell so that the soft parts of the body can be withdrawn completely into it. The slugs are without a shell, or only have much reduced or internal shell. Snails and slugs are hermaphrodites but there is reciprocal exchange of spermatozoa as they mature before development of eggs. They are very active during night hours when the temperature drops and at day time they rest in moist places or under debris. Snails secrete light yellow slime and slugs secrete colourless slime which becomes silvery after drying. Nearly 1450 snails and slugs are recorded in India. The North-East Indian states have highest diversity of gastropod

Giant African snail on banana

Cornu aspersum

snail on coconut Tree

snail on banana Tree

followed by the Western Ghats. Some species of snails and 12 species of slugs have been found to damage both horticultural and field crops.

Morphology and biology of major species of snails and slugs

Both Snails and slugs are hermaphrodites. Mating usually takes place after summer when favourable moist conditions return. The mating individuals (couple) of snails and slugs can lay eggs.

They begin to lay spherical white coloured eggs into moist soil two to four weeks after mating. The incubation period is 2-4 weeks. The hatched out young ones take one year to attain sexual maturity.

(i) Giant African snail *(Achatina fulica):* The Giant African Land Snail is one of the largest terrestrial gastropod coming under the family Achatinidae. They have light to dark brown shells with vertical stripes of darker shade of brown on them. The average total life span is about 5-7 years. But, under favourable condition some of them can live up to 10 years. The fecundity range is 50-200 eggs per individual in a year. An individual snail can lay about 1000 eggs in its total life span of five years.

(ii) Garden slug *(Laevicaulis alte):* It is also known as tropical leather leaf and comes under the family Veronicellidae. It is usually found in soil under debris during summer months. They are much active in cool and damp situations. *Laevicaulis alte* is a round, dark-coloured slug with absence of shell. Its skin is slightly tuberculated and measures 7 or 8 cm. This slug has very narrow foot and small tentacles of 2-3 mm length. Eggs are laid in groups of 6-45 numbers in moist soil. Eggs are oval & creamy white in colour. Incubation period ranges from 9-18 days with an average of about 13 days. They become sexually matured adults within a period of 240- 323 days. Its average body size is 55 mm broad and 50 mm long.

(iii) Garden snail *(Cornu aspersum):* It is also known as land snail. This snail is

Giant African snail

consumed as a food item in some areas. It comes under the family Helicidae.

Previously it was classified under the name *Helix aspera,* but now categorized in the genus *Cornu*. It is a medium sized snail with a helical shell. The colour of the shell is yellow-brown and may possess darker brown spiral stripes with banded appearance due to the presence of irregular markings and streaks. The garden snail can lay as many as 80 eggs per clutch. The juveniles of this species will achieve maturity in 1-2 years. The average life span is 4-5 years.

Damage caused by Gastropods

Snails and slugs appear as sporadic pests in those places where damp conditions prevail. When the population is high, they do serious damage. They prefer to feed on plants having succulent foliage and flowers. Based on the presence of silvery mucous trails the damage caused by the snails and slugs is confirmed.

The Giant African snail is known to feed on at least 500 species of plants. It got its invasion into India during 1847. It is found to attack many crops viz., cereals, vegetables, fruits, ornamentals, coffee arecanut etc.. On orchids it feed on the young leaves, roots, flower buds and even open flowers. Papaya is one of the preferred fruits which are seriously damaged by *A. fulica,* resulting in falling and decaying of fruit. It is known to transmit black rot disease in cocoa caused by *Phytophthora palmivora*.

The slug species *Laevicaulis* alte feeds on cucumber, apple, spinach, carrot, a number of ornamental plants like balsam, portulaca, pot- marigold, verbena, dahlia, cosmos and lily. In tomato it nibbles the skin first and then the pulp.

The *Cornu aspersum* is primarily a herbivore having wide range on host plants. It feeds of numerous types of fruit trees, vegetable crops, rose bushes, garden flowers and cereals.

The horntail snail *Macrochlamys indica* is found to feed on seedlings, fallen & decomposed leaves, vegetables such as beans, lettuce, cabbage,

Laevicaulis alte

cauliflower, cucurbits and fruit crops viz., papaya, banana, guava. The ornamentals crops marigold, chrysanthemum, hibiscus, roses etc.are also damaged by the *M. indica*.

The snail *Indrella* ampulla is a serious pest on cardamom plants.

Apart from being a pest on crops, they may also appear in large number on roads and runways, creating problems during the taking- off or the landing of the aircraft.

Management

- If population is low, hand picking of snails and slugs and putting into a bucket containing 1% common salt is very effective. This method can be done only in the dark hours since snails move freely after dusk.
- A physical barrier / protective border can be used to prevent the movement to the crop. Application of common salt, saw dust, ash, lime and copper sulphate as barrier line is effective to prevent the entry.
- Mechanical barriers such as copper or zinc sheets of 0.8 mm thickness can be used.
- Spray copper sulphate 3% @ 5 kg dissolved in 160 lt. of water per acre.
- Dust metaldehyde 15% D @20 kg per acre or sprinkle metaldehyde 2.5% pellets around the infested fields.
- The voracious predatory snail / cannibal snail *Euglandina rosea* may be used against snails and slugs.

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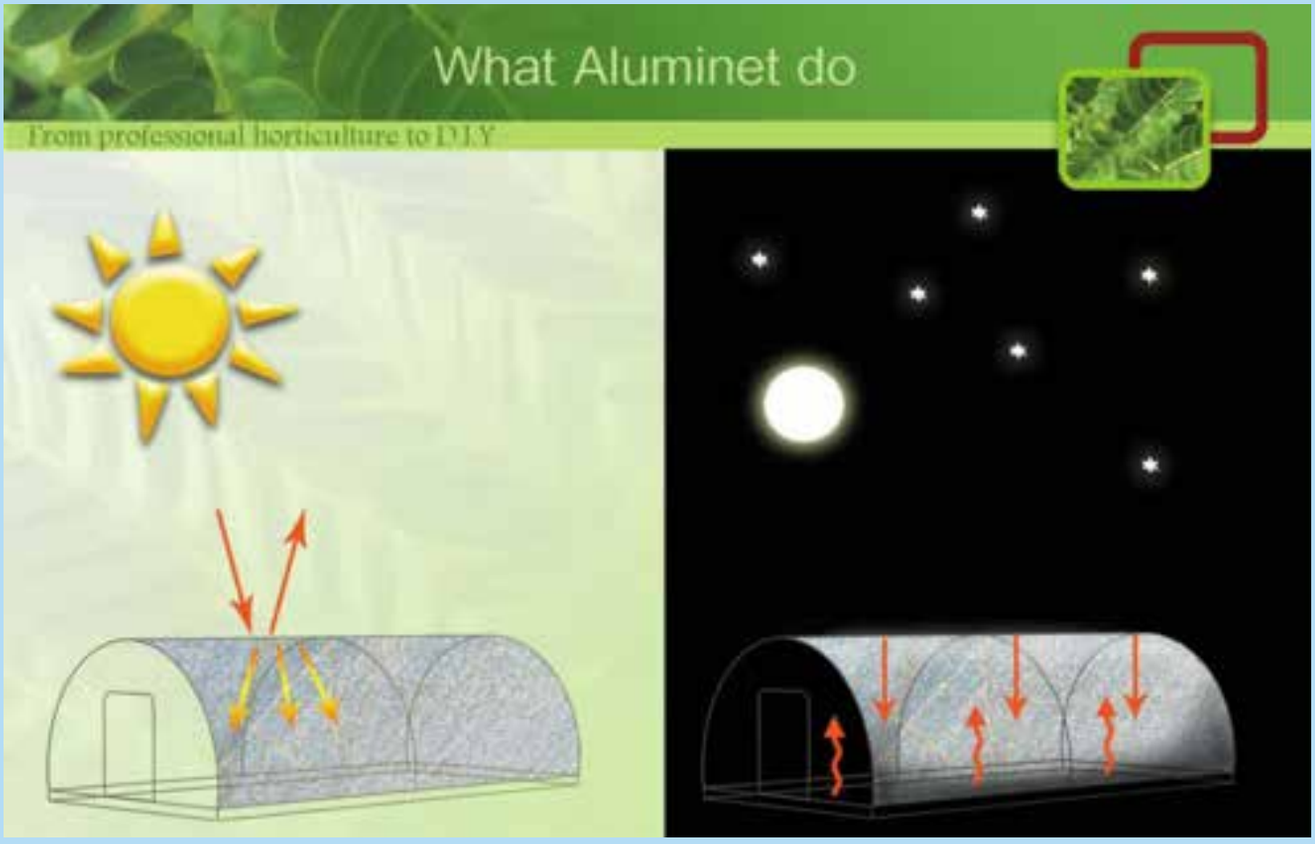
ALUMINET - THERMO REFLECTIVE SCREEN

A brand new technology for Net house of tropical regions

Build-up of heat is the major problem in green houses of tropical regions during summer. Hence, the net-house construction is getting popularity in locations where the temperature is too high and rainfall is moderate. Here comes the use of new technology called Aluminet. It is a high quality reflective metalized HDPE knitted screen giving the fiber material like durability and longevity. These properties allow Aluminet to function like a mirror during summer months as its unique aluminized fibers reflect unwanted sunlight and heat from greenhouse. These same properties also serve to retain valuable heat during the winter months.

Used in greenhouse thermal screens and as an



alternative to black shade cloth. It is specially treated to prevent oxidation and protects against frost radiation damages. It comes with unique properties which help to repel several pests including thrips. Main advantage of this net is moderation of day/ night temperatures. Ease in installation and operation of this net are attributed to its light weight and high elasticity.

Energy saving: Aluminet screens have been tested and proved to save higher amount of heat energy by reflecting a part of energy to the outer environment, which means direct reduction of operational costs in case of electrically cooled polyhouses and also in naturally ventilated polyhouses and net-houses.

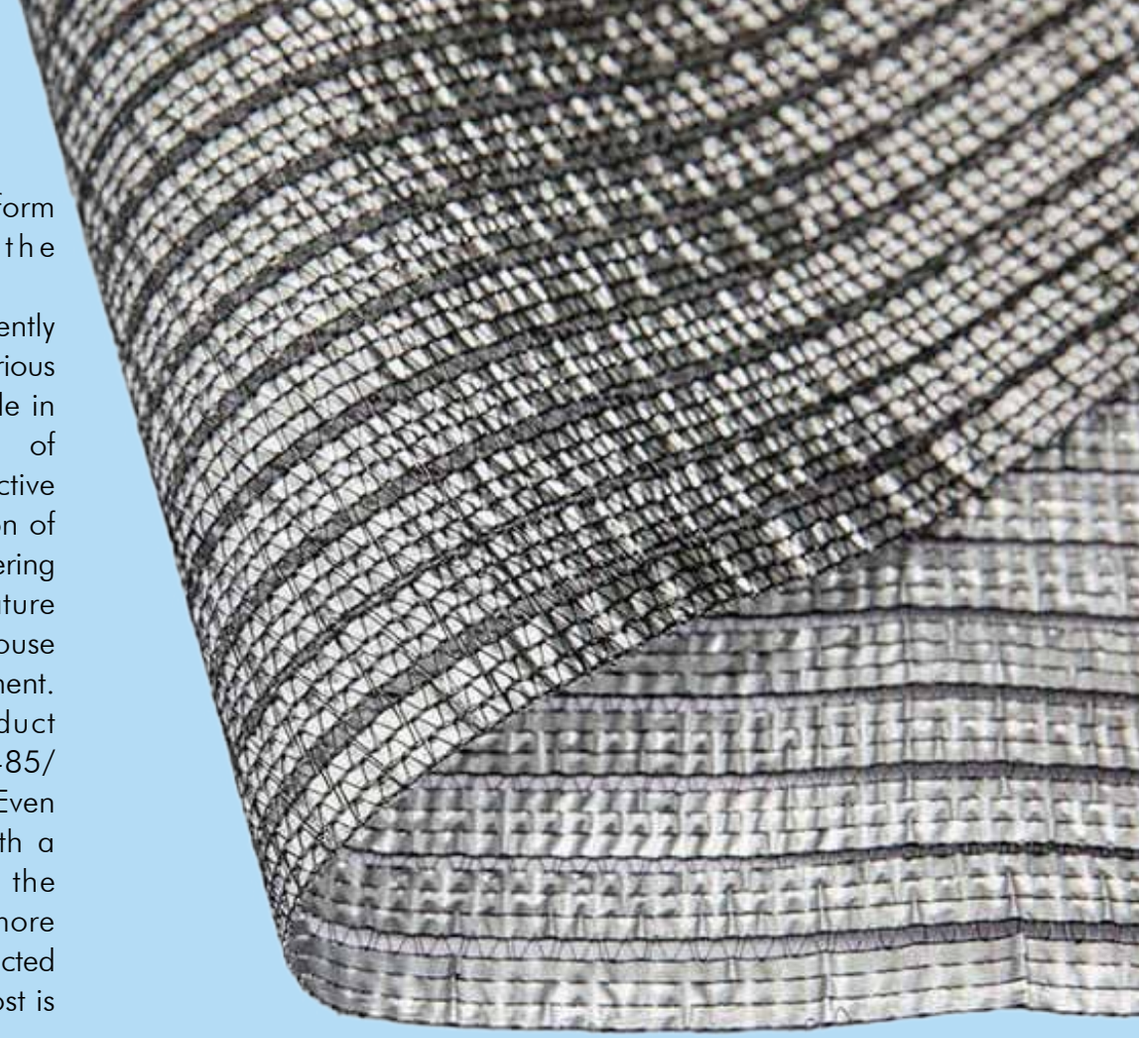
Yield increment: Better temperature control, together with optimized light management, ensure maximum yield from greenhouse. Aluminet screens raise plant temperatures at night, avoid overheating in the day and improve photosynthesis by increasing the amount of scattered light within the greenhouse or net-house.

Protects against frost: Many outdoor crops benefit from improved climate management. Aluminet screens installed on light-frame shade houses protect crops from frost, wind and heat stress, increasing both crop quality and productivity.

Durability: Aluminet screens carry a long-term guarantee on product quality and depending on the manufacturers, the durability will vary. The companies' quality assurance policies generally focus on supply of quality products to its customers for long-term use under harsh and diverse field conditions. On an average one can expect a life of 6-8 years from the installation.

How Does It Work?

- **Double-side reflection:** Aluminet screens reflect sun radiation during the day, reducing overexposure to heat, and reflect IR radiation at night, increasing plant temperature and reducing risk of freezing. The screens also prevent condensation on leaves.
- **Light Diffusion:** Aluminet's special texture improves light management. The use of special additives and the multifaceted reflection of the twisted Aluminet strips contribute to efficient diffusion of incoming

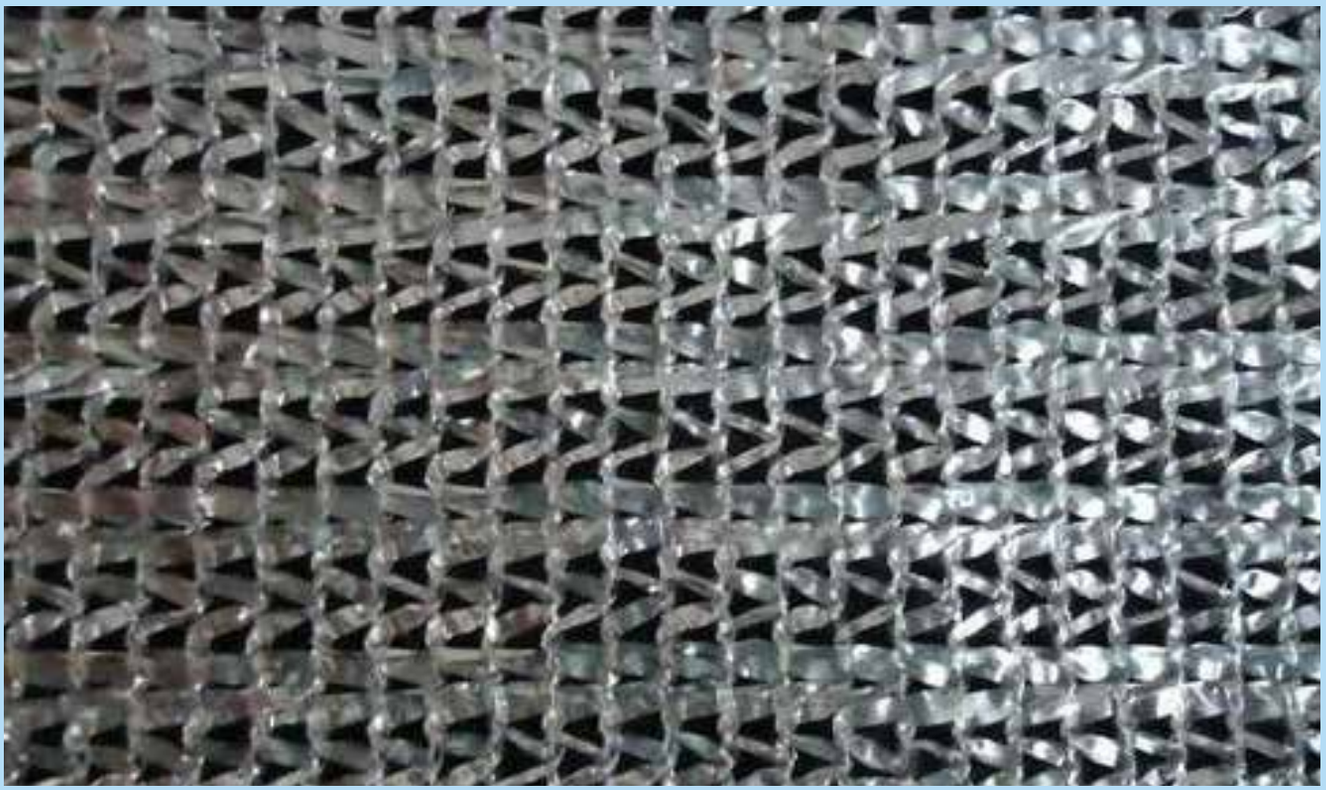


radiation, creating uniform light throughout the greenhouse.

Available variants: Presently Aluminet are produced by various manufacturers and available in variety ranging from shade of 40-43% to 70-74% respective to diffused light transmission of 72-45% which results in lowering of around 5-7°C temperature within net-house or greenhouse compared to outer environment.

Currently the product may cost approx. Rs. 76-85/ m^2 in the Indian markets. Even though this net comes with a large bunch of benefits, the market will expand and more growers/farmers will be attracted towards it only when the cost is reduced considerably.

Hence manufacturers need to orient their production systems to make it more sustainable and more cost effective. They have to expand their market to make it affordable even to the small and marginal farmers who are the major players in Indian agriculture system.



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Aloe
A Miracle Plant

Aloe species are perennial succulents belonging to the family Liliaceae. They are the source of drug called 'aloe'. The name Aloe comes from the Arabic word 'alloeh' meaning a "shining bitter substance" and 'vera' in Latin means 'true'. The botanical name is *Aloe barbadensis* Miller. As per the Egyptians, Aloe is "the plant of immortality." In Ayurveda, Aloe is known as Kumari or "Young Girl". It is because; aloe is believed to bring back youthful energy and femininity. It grows mainly in dry regions of India, Africa, America,

Europe, Venezuela, Aruba, Bonaire and Haiti. In India, it is found in Maharashtra, Andhra Pradesh,Gujarat, Rajasthan, Tamil Nadu and Karnataka.

Aloe is obtained by cutting the leaves at their base and letting the yellow bitter juice drain out. This is present in the group of specialized cells known as the pericyclic tubules. After extraction, the water is evaporated off from the juice by heat and the resulting light to dark-brown mass is the 'durg aloe'. Of the two major products derived from the leaves, the yellow bitter juice present in specialized cells beneath the thick epidermis yields the drug aloe and the parenchymatous tissue in the centre of the leaf contains a mucilaginous gel which yields aloe gel or aloe vera gel. Aloe vera gel is currently obtained from *A. barbadensis*. This gel is a clear, tasteless, thin, jelly like material.

There are over 100 active biologic constituents found within aloe. It contains cathartic anthraglycosides as its active principles; these are mostly C-glucosides, notably barbaloin, which is a glucoside of aloe emodin. The concentrations of these glucosides vary with the types of aloe ranging form 4.5 to 25 per cent of aloin. Other constituents present include aloesin and its aglycone aloesone (a chromone), free anthraquinones (e.g. aloe-emodin) and resins.

Aloe vera gel contains 99 per cent of water with a pH of 4.5 and it has glucomannan which is a polysaccharide and

is believed to be the active constituent. Other constituents reported or otherwise claimed to be present include other polysaccharides (containing galactose, xylose and arabinose), steroids, organic acids, enzymes, antibiotic principles, amino acids, "biogenic stimulators", "wound healing hormones", saponins, minerals and it provides vitamin C, A, E, B, β-Carotene, Zinc, Calcium, Copper,Magnesium, Manganese and phosphates. It also contains four plants steroids like campestrol, cholesterol, bsitosterol and Fresh aloe vera gel is well known for its domestic medicinal values. For this reason Aloe vera is also called "burn", "first aid" or "medicine" plant. When freshly obtained, the gel has the property of relieving thermal burn and sunburn as well as promoting wound healing. It also has moisturizing and emollient properties. Aloe is also believed to give good solution to all the three Ayurveda constitutions, Vatha, Pitha and Kapha.The plant is used as a home remedy for these purposes. The only officially recognized use of aloe is, as an ingredient in skin treatment owing to its beneficial properties on the skin. Gel have anti-tumor, anti-ulcer effects, anti-bacterial, anti-viral activity, anti-septic and analgesic properties

Aloe and aloin are extensively used as active ingredients in laxative preparations. Aloin is also used in antiobesity prepration. Aloe gel and sometimes drug aloe are used as moisturizer, emollient or wound healer in various cosmetic and pharmaceutical formulations.

Extracts of aloe or aloin are used in sun screen, x-ray burns, dermatitis, cutaneous leishmaniasis and other cosmetic prepartions. Now a days, Aloe vera is widely used in food. It is also approved by the FDA as a flavoring agent & as a food supplement. It is also a main ingredient in many herbal remedies and extracts are used as a flavour ingredient primarily in alcoholic and non-alcoholic beverages and in candy to impart a bitter note.

Soil and climate

Aloe is a hardy plant and grows on a variety of soils. It comes up well in the sandy coastal soils to loamy soils of plains with pH upto 8.5. However, water logged conditions and problamatic soils does not suit for its cultivation. Aloe is cultivated during the period between March and June. The plant has a wide adaptability and can be seen growing throughout the length and breadth of the country. It is found growing in warm humid or dry. With even 150-200 cm to about 35-40 cm yearly rainfall during the growing period. However, in dry regions the crop should be provided with protective irrigations.

Cultivation

Propagation

The plants are generally propagated by root suckers or rhizome cuttings.

Land preparation

The land should be ploughed twice and the field should be cleaned thoroughly for the weeds. If required, small canals may be prepared for drainage. About 25 tonnes of cowdung manure per hectare is added during land preparation.

Planting

Itis to be planted at a spacing of 60 x 30 cm or 60 x 45 cm. About 15-18 cm long root suckers or rhizome cuttings are planted in such a way that 2/3rd portion of the root sucker or rhizome cutting should be under the ground.

Manuring

It is a newly domesticated crop and its full production technology including manurial requirement is yet to be worked out. On adhoc basis, application of a mixture of 150 kg per hectare of nitrogen, potassium and phosphorus is recommended. The fertilizers are applied in soil near the root system after the plants are established.

Irrigation

Immediately after planting, the land is irrigated. During the crop period irrigation must be given according to the moisture content of the soil. Generally, 4 to 5 irrigations per year is sufficient. Water should not be allowed to lodge near the plant.

Weeding

Weeding may be done twice a year. The land is to be kept weed free.

Pests and diseases

Leaf-spot disease caused by *Altarnaria alternata* and *Fusarium solani* is reported from some areas.

Harvesting and yield

The plants are harvested 8 months after planting. While harvesting the plants can be removed manually or with the help of Tractor drawn Disc Harrow or cultivator. The broken rhizome parts left in the soil throws out new sprouts in spring for raising the succeeding crop. An Aloe plantation gives commercial yield from second year upto an age of 5 years, where after it needs replantation.

The yield of the crop on fresh weight basis will be around 10,000-12,000 kg per hectare.

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Basics of Pulse Processing

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Introduction

Pulses are edible dry seeds of plants belonging to the leguminosae family. Pulses are a rich source of dietary protein (vegetable), minerals, and fibres which fulfil the majority of our energy requirements. In general, pulses are used for human consumption and animal feeding. Major pulse species consumed by humans encompass common bean, dry pea, cowpea, urd bean, chickpea, lentil, mung bean, and pigeon pea while common animal feed pulses include: dry pea, faba beans, and lupin. The nutrition profile of common pulses, relative to cereals is shown in Table 1. Pulses are an integral part of the Indian diet providing protein and aids to carbohydrate-rich diet for a complete typical Indian meal. Pulses contain 20-25% protein by weight which is double the protein content of wheat and three times that of rice (APEDA). The level of daily intake of pulses recommended in the dietary guidelines for India is shown in Table 2. Pulses can play a critical role in addressing national food and nutritional security.

India is the largest pulse producer and consumer in the world contributing 28-29% of global production (FAOSTAT; DPD, MoA & FW, 2018). In India, the area under pulses production is 299.93 lakh ha with 252.35 lakh tons of production and 841 kg/ha of productivity during 2017-18 (DPD, MoA&FW, 2018). Moreover, pulses share 9-10% of the national total food grain basket. India has exported nearly 2.35 lakh tons of pulses worth Rs.1, 533.69 crores to the world during the year 2019-20 (APEDA). Pulses are generally grown across the country and can be divided into five important major pulse growing zones/agro-climatic zones (Table 3). Based on the area and production, central zone leads among all the five zones comprising Madhya Pradesh, Maharashtra, parts of Karnataka and Andhra Pradesh. Major pulses producing states are shown in Figure 1 (Source: Farmers' Portal, MoA&FW).

The seed coat or hull accounts for 7-15% of the whole seed mass. Cotyledons are about 85% of the seed mass, and the embryo constitutes the remaining 1-4%. The external structures of the seed are the testa (i.e., seed coat), hilum (seed attached to the stalk), micropyle (opening of seed coat), and raphe (ridge on the side of the hilum). When the seed coat is removed from the grain, the remaining part is the embryonic structure. The embryonic structure consists of two cotyledons (or seed leaves) and a short axis above and below them. The two cotyledons are not physically attached to each other except at the axis and weak protection provided by the seed coat.

In general, the term pulses is limited to crops harvested solely for dry grain, thereby excluding crops harvested green for food mainly as vegetables (peas, beans, etc.), crops used mainly for oil extraction (e.g. soybean and groundnut), and leguminous crops for sowing purpose (e.g. seeds of clover and alfalfa). legume fruit is a simple dry fruit that develops from a simple carpel and usually dehisces (opens along a seam) on two sides. Common name for this type of fruit is pod. All pulses have a similar structure but differ in color, shape, size, and thickness of the seed coat. Mature seeds have three major components: the seed coat, the cotyledons, and the embryo (Fig. 2).

Indian farmers usually find pulse production unattractive due to the low productivity of crops followed by a lack of an assured market. Processing and value addition of the produce at the production site and direct marketing is a feasible solution for increasing farmer's income rather than selling the raw produce. Hence, pulse milling has a huge potential. This dal is an integral part of the Indian diet. Pulses are consumed as fresh vegetables, fermented products, sprouts, flour and dal. According to an estimate, 75% of pulses produced are processed for making dal using mills of different capacities. Pulse milling is the third-largest food processing industry in the country after rice and flour milling. In India, total harvest and post-harvest losses for pulses range from 6.4% to 8.4% (Nanda et al., 2012) prominently due to vermin and insect infestation, early harvesting, physical losses at milling, processing at inappropriate moisture level,

Table 1: Nutrition profile of common pulses, relative to cereals (per 100 g edible portion on a fresh weight basis; Adapted from Rawal and Navarro, 2019)

Name	Energy (kcal)	Protein (g)	Fat (g)	Dietary fibre (g)	Available carbohydrate (g)
Pulses (whole)					
Adzuki bean, raw	318	20.5	0.6	13.1	51.3
Bambara bean, raw	325	18.4	6.4	28.9	33.7
Black turtle bean, raw	306	22.2	1.8	21.1	39.7
Chickpea, raw	337	20.4	5.2	20.7	42.0
Chickpea, *desi*, raw	332	21.2	5.0	21.2	40.0
Chickpea, *kabuli,* raw	359	20.8	6.1	13.1	48.9
Cowpea, raw	324	22.5	1.9	14.6	46.9
Faba bean, raw	309	25.3	1.4	20.8	38.3
Hyacinth bean, raw	316	23.2	1.5	16.2	44.2
Kidney bean, red, raw	307	22.8	1.6	21.7	39.4
Lentil, raw	324	24.4	1.5	17.0	44.8
Lupin, raw *(Lupinus spp.)*	309	34.1	6.5	35.3	10.8
Moth bean, raw	326	23.9	1.9	14.9	45.9
Mung bean, raw	325	20.9	1.3	15.4	49.6
Navy bean, raw	311	21.8	1.8	18.6	42.6
Pea, raw	310	23.4	2.1	22.2	38.4
Pigeonpea, raw	306	20.6	1.8	21.4	41.0

Table 2: Level of daily intake of pulses recommended in the dietary guidelines for India (gram/day; Adapted from Rawal and Navarro, 2019)

Age (years) egg/meat/fish	Vegetarian diet with dairy	Diet that include a portion of products
0.5-1 (Infants)	7.5	-
1-3	30	15
4-6	30	15
7-9	60	30
10-12	60	30
13-15	60 (75)	30 (37)
16-18	75 (90)	37 (45)
Adults (of sedentary physical activity level)	60 (75)	30 (37)
Adults (of moderate physical activity level)	75 (90)	37 (45)
Adults (of heavy physical activity level)	90 (120)	45 (60)

Note: Figures in parentheses give the recommended level of intake for men for ages where a different level of intake is recommended for men and women.

Table 3: Important major pulse growing zones / agro-climatic zones (Farmers' Portal, MoA&FW)

Zone	Area
Northern Hills	Zone Jammu & Kashmir, Himachal Pradesh, North West of Uttar Pradesh
North West Plain Zone North East Plain Zone	Haryana, Punjab, Rajasthan, Gujarat, Western Uttar Pradesh Eastern Uttar Pradesh, Bihar, West Bengal, Assam, Tripura Mizoram, Northern Odisha
Central Zone	Madhya Pradesh, Maharashtra, Parts of Karnataka and Andhra Pradesh
South Zone	Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Southern Odisha

and physical losses due to poor primary and secondary processing techniques. Thus, to minimize these losses for pulses effective post-harvest management is required. Pulses pass through a number of stages in a long and sometimes complex chain from harvest to consumption.

Pulse milling process

India ranks first in pulse-processing and milling capacity globally with 18000 thousand tonnes (Rawal and Navarro, 2019). Whole pulses are milled to recover the splits or dal. In general, pulse milling or dal milling consists of two primary operations: (i) dehulling - loosening and removal of seed coat for producing polished seed having two glued cotyledons; (ii) splitting-loosening and cleavage of cotyledons to produce splits or dal. During milling, dehulling and splitting often occurs simultaneously. The industrial scale pulse-processing encompassing sequence of operations is shown in Figure 3.

Gum present between hull and cotyledon binds them together. Chemical nature and quantity of gum determine the strength of attachment of hull and cotyledon. Based on the bond between hull and cotyledons, the pulses can be

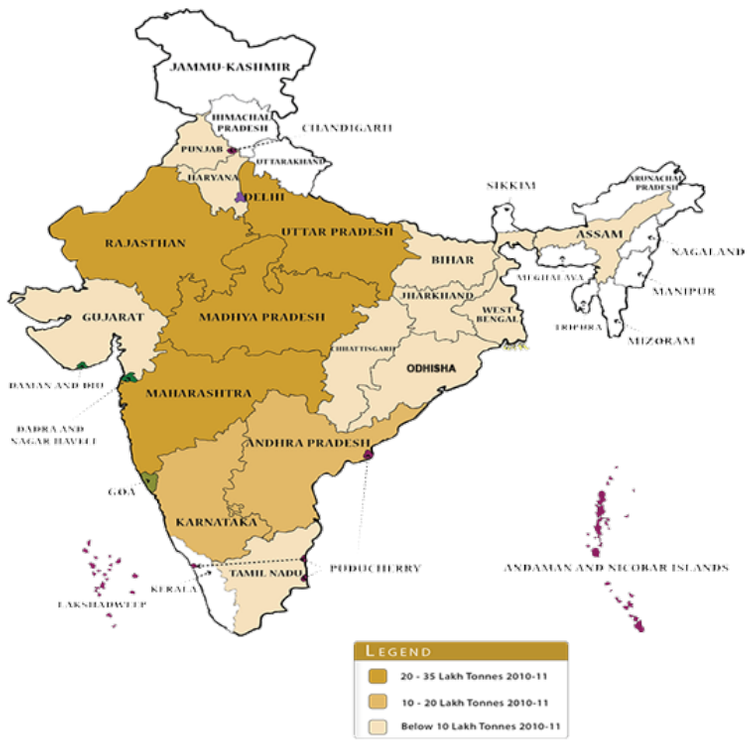


Fig. 1: Major pulse producing states in India (Source: Farmers' Portal, MoA&FW).

Table 5: Dehulling machines for pulses (Adapted from Vishwakarma et al., 2018)

S. N.	Dehulling	Mechanism	Functional unit	Capacity (kg/h)	Pretreatment method	Dehulling effeciency (max, %)	Dal yield (%)
1	CIAE dal mill	Abrasion	Emery roller concave	100	Wet or oil	80	77
2	PKV mini dal mill	Abrasion	Emery roller concave	125-150	Oil	83	74
3	CFTRI mini dal mill	Abrasion n and shear	Truncated cone type emery concave	100-150	Oil and heating	87	80
4	IIPR dal chakki	Abrasio n and impact	Vertical plate mill (metal and rubber)	75-80	Oil	88	76
5	Pantnagar dal mill	Abrasion	Emery roller concave	75-80	$NaHCO_3$ solution	80	80
6	IARI mini dal mill	Abrasion	Emery roller concave	120-140	Wet	80	83
7	PRL batch dehuller	Abrasion by abrasive discs	Emery disc concave	7	-	-	-
8	Schule dehulling machine	Abrasion by abrasive discs	Vertically placed emery discs cylinder	16000	-	-	-
9	S. K. Engi neering and Allied Works, India	Abrasion	Truncated cone type emery concave	500-2000	Oil and heating	85	-
10	ICRISAT mini dehulling mill	Abrasion and impact	Horizontal stone plates	500-2000	40	Oil	71
11	TNAU dhal mill	Abrasion and impact	Horizontal stone plates	-	Wet	-	-

Notes: CIAE: Central Institute of Agricultural Engineering; PKV: Punjabrao Deshmukh Krishi Vidyapeeth; CFTRI: Central Food Technological Research Institute; IARI: Indian Agricultural Research Institute; PRL: Prairie Research Laboratory; ICRISAT: International Crops Research Institute for the Semi-Arid Tropics; TNAU: Tamil Nadu Agricultural University.

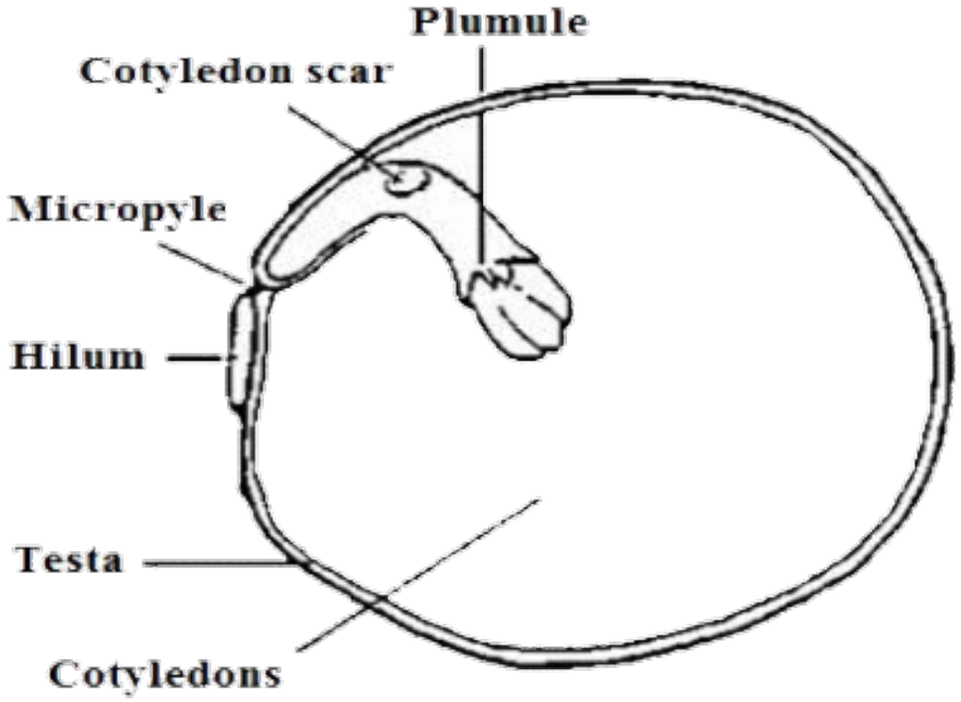


Fig. 2: Structure of pulse (Source: e-Krishi Shiksha, ICAR).

divided into two categories, namely, difficult to mill pulses and easy to mill pulses. Difficult to mill pulses demand repetitive pretreatments with multiple passes through a dehulling machine (pigeon pea, black gram, green gram, beans). On the contrary, easy-to-mill pulses require pretreatment only once followed by one or two passes through a dehulling machine (chickpea, dry peas, lentil). Each pulse has easy- and difficult-to-mill cultivars, for example, desi chickpea dehulled properly in one pass, Kabuli chickpea seeds numerous passages. The operation involves in the milling of pulses is listed below.

1. Cleaning and grading

After harvesting the dried raw grains/pulses received in a milling plant are first cleaned and graded. In cleaning, various types of impurities present in grains are removed with the help of air draft or screens. The cleaned grains are then graded as per their size by air screen cleaner cum grader.

2. Pitting

The cleaned pulses are passed through an emery roller machine. In this unit, the husk of a pulse is cracked and scratched. This is done generally to facilitate the subsequent oil or water penetration process for loosening the husk. The clearance between the emery roller and cage (housing) gradually narrows from inlet to outlet. This narrowing clearance helps in cracking and scratching of husk due to friction between pulses and emery roller.

3.Conditioning / Pre-Milling treatment

In India food legumes are consumed in dehusked or split form. Pulses contain a layer of gum between cotyledons and outer husk/hull/seed coat that determines the adherence of seed coat to cotyledons and also severity (time and treatment) of the conditioning process. The pre-milling treatment is done on the hull to reduce the strength of its bond with cotyledons and separate it by application of mechanical action. These are generally employed to loosen the seed coat, reduce breakage and improve end-product quality. This, aids in reducing the milling losses. Conditioning is usually done by alternate wetting and drying. Pulses are soaked/dried and temporary moisture of 3-5% was added and then after about 8 hours, the grains are sun-dried. This whole process of alternate wetting and drying is continued for 2-4 days until pulses are sufficiently conditioned. Pulses are finally dried to about 10-12% moisture content prior to

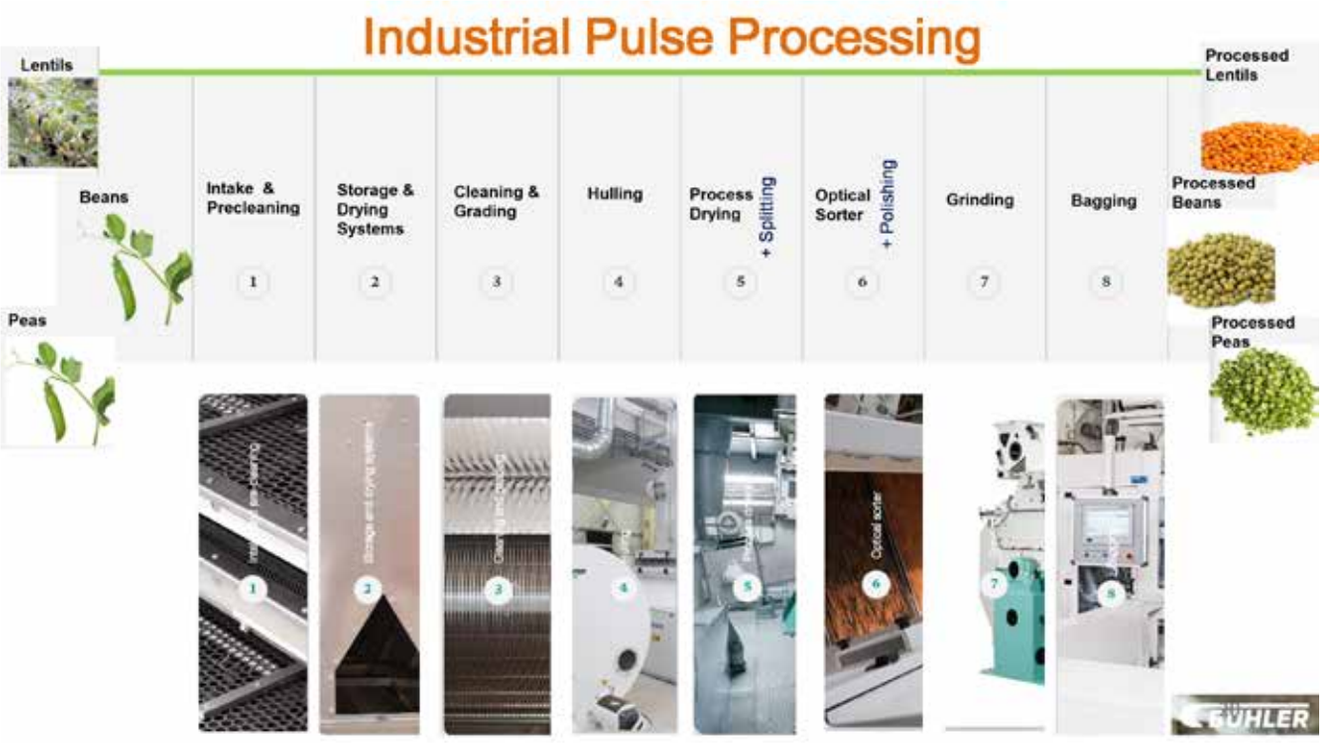
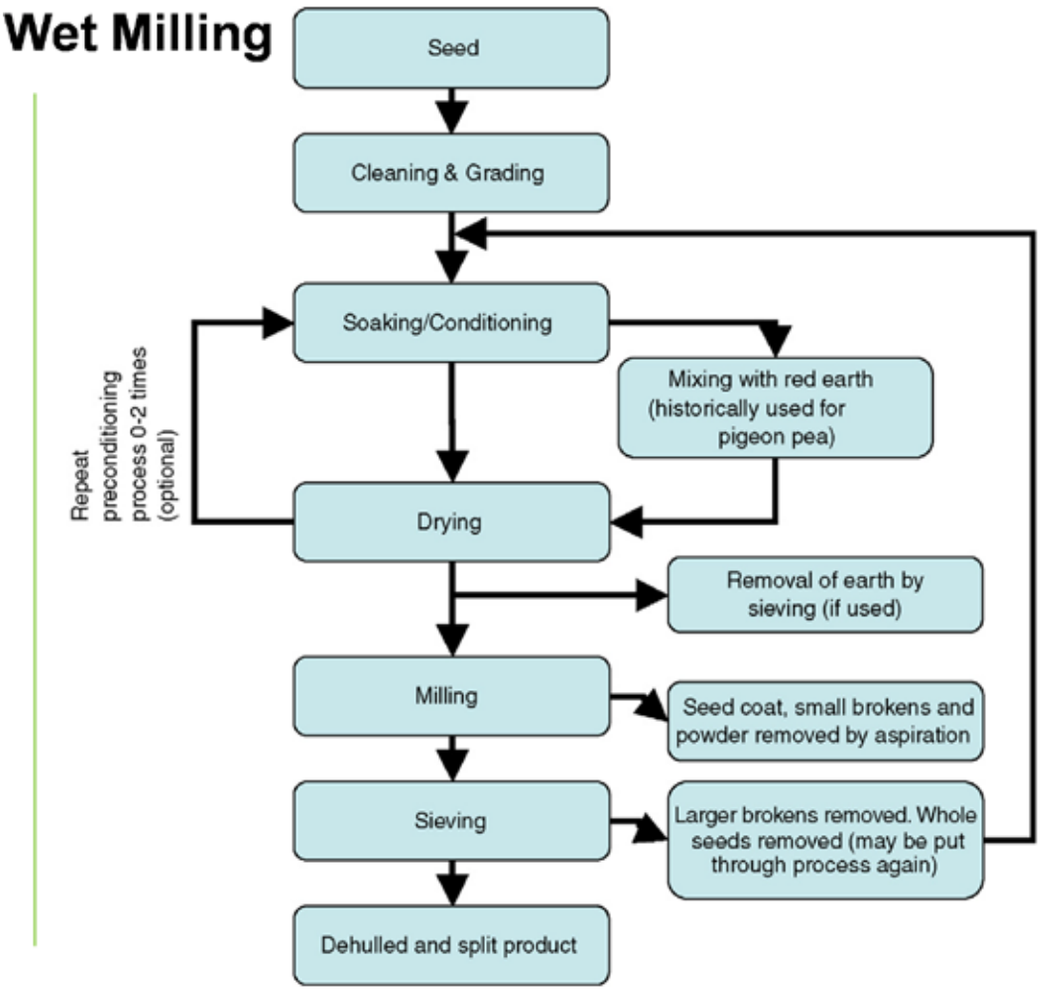


Fig. 3: Industrial pulse processing (Modified from: Bühler)



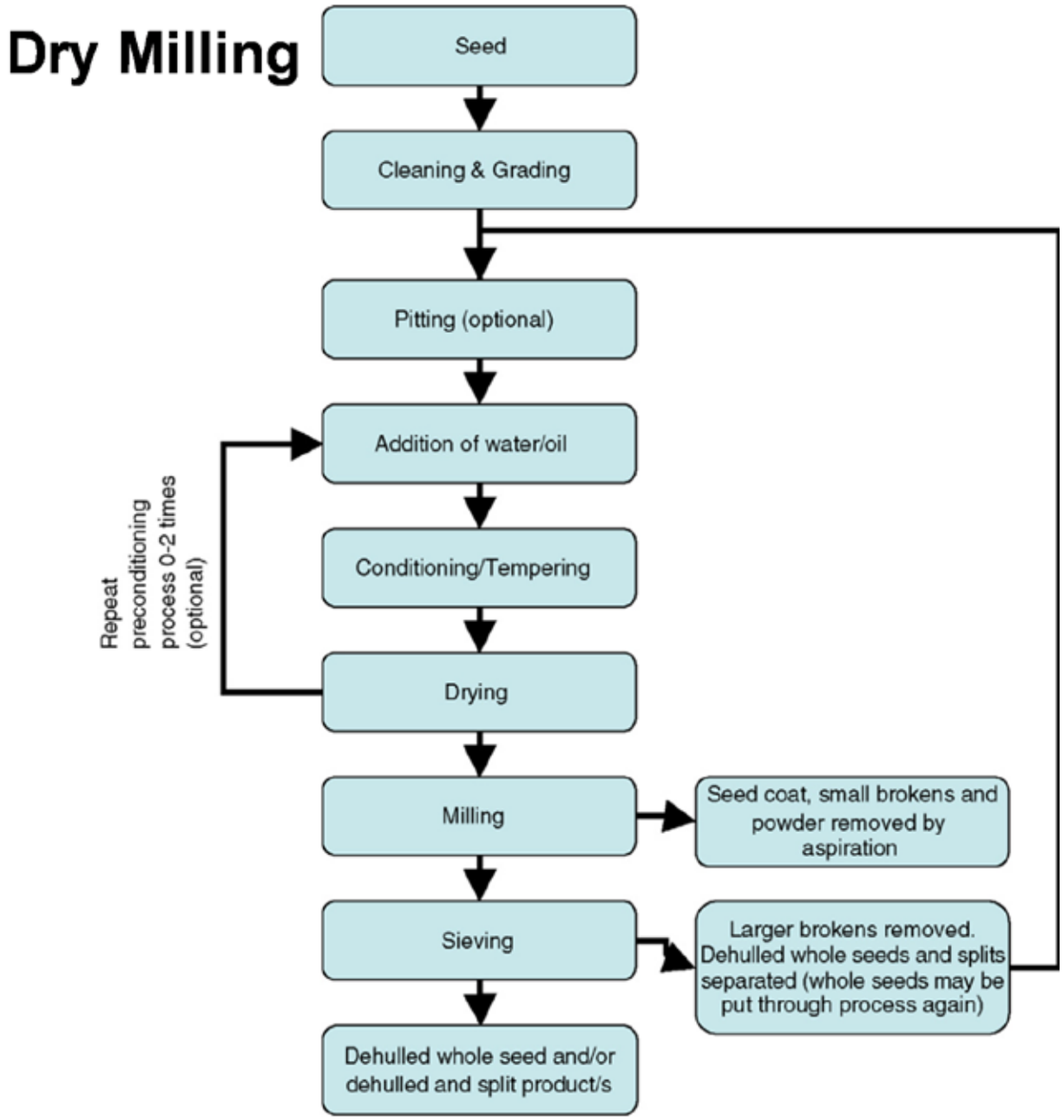
dehusking and splitting. Some of the common pre-milling treatment methods are given below.

- Dry treatment method (oil; oil and water)
- Wet method
- Thermal treatment
- Chemical treatment: 1. Vinegar treatment; 2. NaHCO3 and NaCl treatment
- Enzymatic treatment
- Microwave treatment

The two most common conditioning methods, that is, wet treatment and dry treatment (Fig. 4) are discussed further.

Wet treatment / milling

In the wet treatment method or wet milling (Fig. 4a), soaking and drying are the effective techniques for loosening the husk and therefore, this



method is weather-dependent and labor-intensive. About 95-98% of the grains are milled by this method. Dal produced by this method cooks better but takes a longer time. The grains are soaked in water for about 12 hours and then, mixed thoroughly with the paste of red earth. After that, the grains are heaped for about 16 hours and spread in drying yards in thin layers for 2-4 days. After drying, red earth is removed by sieving, and the grains are milled by power-operated stone or emery coated vertical chakki to yield dal.

Dry treatment / milling

Dal produced by dry method or dry milling cooks faster but losses are high due to breaking and powdering. In this method, the most important step is application of oil/water (Fig. 4b). In this method, the pulses are mixed thoroughly with 1% edible oil (generally linseed oil) and sun-dried in thin layers for 2-3 days. After drying, about 2-5% water is sprayed and mixed uniformly, and then, grains are tempered overnight. Finally, grains are passed through roller machines for dehusking of grains.

4. Dehusking and splitting

Dehusking and splitting are the major unit operations in pulse milling. In this process husk is removed from conditioned grains and cotyledons are split into two equal halves by subjecting to abrasive rolls.

In some milling plants, vertical stone chakki is used and sometimes vertical disc burr mill can be used for splitting dehusked and moistened grains. Dehulling machines developed in India for pulses are shown in Table 5.

5. Polishing

Polishing helps in giving desirable shine and lustre to dal. In this process, when the dal is passed through the screw conveyor, desired quantity of edible oil and water is mixed with the dal. The percentage composition of oil and water in milled pulses is responsible for its color and shine.

6. Storage

Dried grains are stored in bulk until required for further processing. If the pulses have picked up moisture it should be re-dried. Pulses are often protected with insecticides and must be stored in rodent-proof containers.

Secondary processing, packaging and marketing

Secondary processing of pulses or 'adding value' to pulses is the utilization of the primary products (dal or flour) to make more interesting products and to add variety to the diet. Secondary processing of pulses includes the following processes: fermentation, baking, puffing, flaking, frying and extrusion. After processing, the products are packed in appropriate packages as per pulses and marketed via an established marketing chain.

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ARSENIC CONTAMINATION

In indian soils and its Mitigation options

Introduction

Arsenic is a chemical element with symbol As, atomic number 33 and it belongs to the group VB of periodic table. Arsenic (As) is a trace toxic element which is of great environmental concern due to its presence in soil, water, plant, animal and human continuum. It is a toxic trace element, which has been affecting many countries including India, especially the areas of Ganga delta basin. It is a metalloid which occurs in many minerals usually in combination with sulphur and metals and may also occur as a pure elemental crystal. Concentration of As tends to be low in above-ground natural water bodies, except the ones characterized by geothermal water or mining activities. Sedimentary rocks are likely to have higher As content as compared to igneous and metamorphic rocks. Arsenic pollution in majority of the cases

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is geogenic in nature and over-exploitation of groundwater for drinking and irrigation purposes has been implicated as the main cause of its pollution. In areas with groundwater As-contamination, soils can act as major sink as well source of As. Arsenic trioxide in a quantity as small as 0.1 g can prove lethal to humans. This high toxicity and increased appearance of As in the biosphere have triggered a serious public and political concern. The symptoms of As poisoning include skin disorders (Fig. 1, Fig. 2), weakness, languor, anorexia, nausea and vomiting with diarrhoea or constipation. As the toxicity increases the symptoms attain more characteristic features, which include acute diarrhoea, skin pigmentation, arsenical melanosis and hyperkeratosis, enlargement of liver, respiratory diseases, skin cancer and death in extreme cases.

Sources of Arsenic contamination in soil

Arsenic can be introduced to the environment either by natural processes (such as during atmospheric emissions or when naturally occurring minerals rich in As are desorbed and dissolved) or by anthropogenic actions (such as over exploitation of groundwater for cultivation purposes, mining, combustion of fossil fuels, metal extraction processes, timber preservatives, etc.). Broken-down rocks and minerals rich in iron and As adsorbed to secondary oxide/ hydroxide precipitates, termed as As traps, might be one of the reasons of high As occurrence in groundwater and soil. Fe^{3+} present on the surface of sediments may adsorb Fe^{2+} during iron oxide reduction. Fe^{2+}, thus adsorbed, reduces arsenate (As^{5+}) to arsenite (As^{3+}). This reaction is responsible for the entry of relatively more toxic and labile As^{3+} in the soils of India.

Arsenic contamination in India

The states of Uttar Pradesh, Bihar, West Bengal and Assam are severely affected. Though first case of arsenicosis was reported from West Bengal in early 1980s, the widespread contamination of As was not recognized until 1995. The first report on the As contamination in the middle Gangetic plain of Bihar was cited by Chakraborti et al. (2003). Drinking water is considered to be the main conduit of As exposure to human. However, since last decade, researchers have been reporting exposure of As via food chain. In fact, rice, after drinking water, is considered to be the second most important source of As in India (Roy et al., 2020). In the year 2008, Mondal and Polya, found rice to be the most important exposure route for As in some areas of West Bengal, India. Elevated genotoxic effect was observed due to the consumption of cooked rice with as more than 200 μg kg-1 (Banerjee et al., 2013). Golui et al.(2017) studied the health hazards associated with consumption of As laden rice grain by the people of Malda district, West Bengal. Presence of As in wheat and maize in the Indo-Gangetic Plain of India was also reported (Mandal et al., 2019a; Mandal et al., 2019b). Although, unlike rice, wheat is not considered to be an accumulator of As but Suman et al.(2020) found As in the grains of wheat with content high enough to cause lifetime cancer risk indicating widespread As exposure from wheat intake in the studied population of Bihar, India. According to World Health Organization (WHO), maximum permissible limit of As in drinking water is 10 ppb and that in rice grain is 1 mg kg-1. The maximum permissible limit of As in rice grain was made more stringent when laid out by United States Department of Agriculture (0.15 mg kg-1) and European Union (0.5 mg kg-1).

However, these permissible limits do not have much practical significance as there exists diversity from region to region with respect to the amount and type of food being consumed. Hence, suitable management and mitigation strategies should be explored.

Amendments for arsenic mitigation

A large number of studies explore the mitigation potential

Table 1.: Amendments that were effective in mitigation of As

Amendments	Observations
Phosphates	Competitive adsorption between inorganic phosphate (Pi) and As (both AsIII and AsV) may occur when Pi is applied to an As-enriched soil
Iron	derivatives Fe-based soil amendments reduce As mobility and toxicity, sorption/coprecipitation of insoluble Fe-As complexes
Zinc derivatives	Suppressing effect of Zn that results in precipitation/fixation of As as Zn-arsenate, which makes As unavailable to plants
Silicates Lime	Competition between As (III) and Si because of their chemical similarities Augmenting As immobilization by the formation of Ca–As precipitates Vermicompost Complexation of As with humic and fulvic acids. Reduction of As accumulation in sesame.
Sugarcane Bagasse	Complexation of As with humic and fulvic acids. Reduction of As accumulation in wheat and maize
Paddy husk	Complexation of As with humic and fulvic acids. Reduction of As accumulation in wheat
Phytoremidiation	Arsenic hyperaccumulator Pteris vittate L. has a great potential

Source: Compiled from various sources

of soil amendments such as the application of inorganic fertilizer, inorganic amendments or organic manure which can immobilize, adsorb, bind or co-precipitate As in situ. The amendments effective in remediation of As and their probable mechanism can be visualized in Table 1.

The organic amendments effective in reducing As content in wheat and Maize can be visualized from Figure 1 and Figure 2, respectively as reported by (Mandal et. al., 2019b). The organic amendments used are as follows:

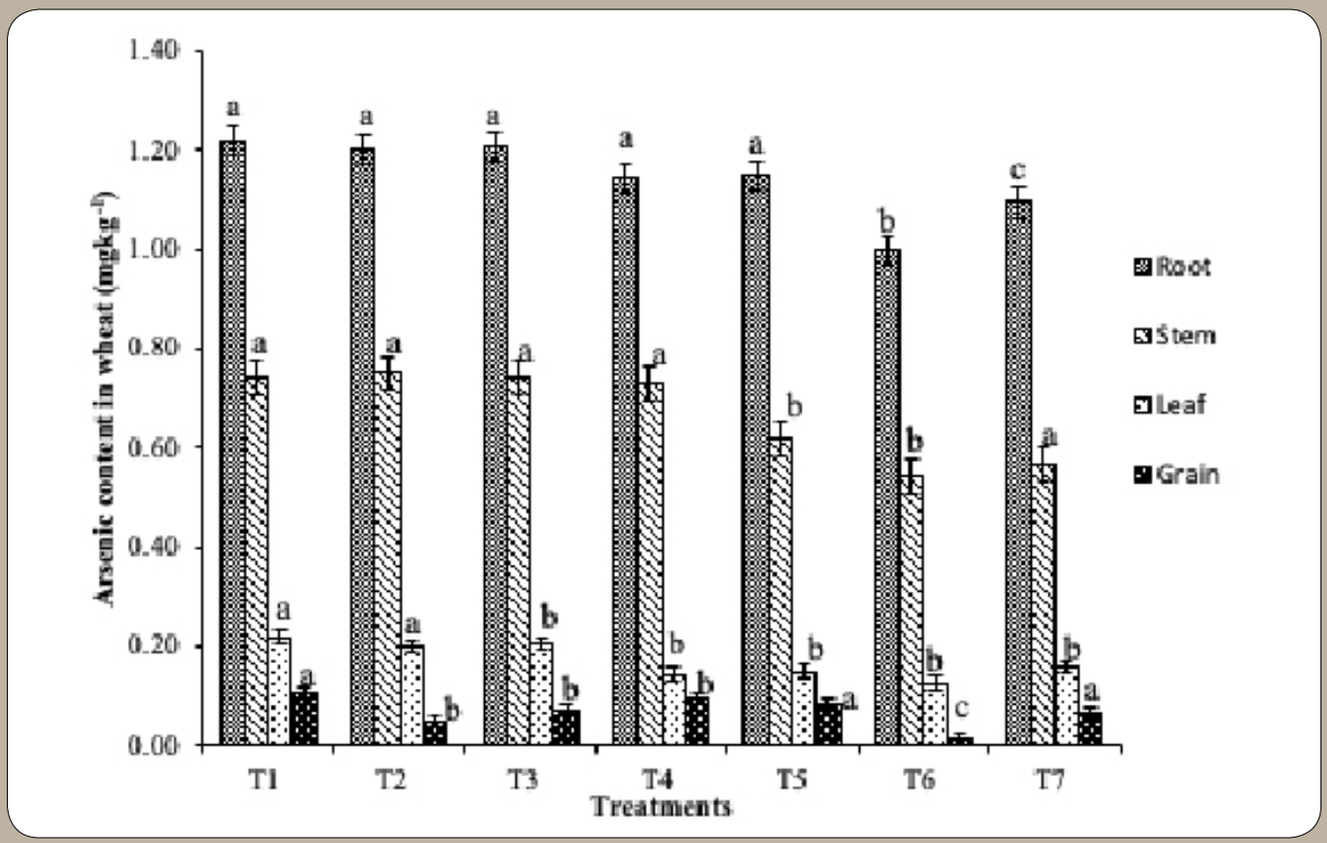

Figure 1. Effect of organic amendments on arsenic accumulation in Wheat.

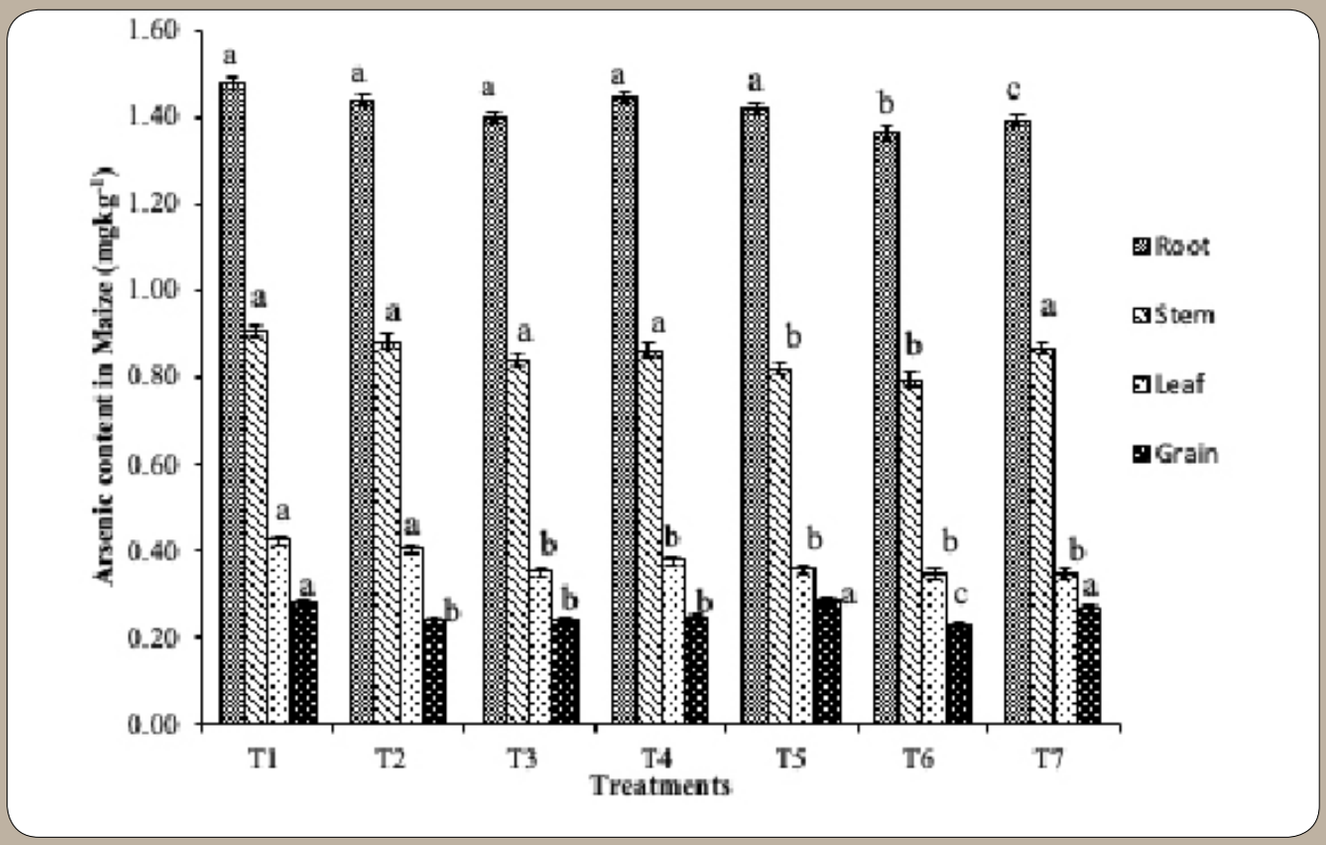

Figure 2. Effect of organic amendments on arsenic accumulation in Maize.

- Control - T1
- Rice straw at the rate of 10 and 20 t ha−1 - T2 and T3
- Farm Yard Manure (FYM) at the rate of 10 t/ha - T4
- Vermicompost (VC) at the rate of 10 t /ha - T5
- Sugarcane bagasse SB at the rate of 10 t /ha -T6,
- Paddy husk (PH) at the rate of 10 t /ha - T7.

Conclusion

The mitigation strategy needs to be location specific, depending on the availability of options. Soil, crop and irrigation-water management strategies are urgently needed to minimize the potential detrimental consequences of As contamination. Concerted efforts are needed to link irrigation water management, bioremediation, breeding to get varieties/crops primed to accumulate less As and other avenues of strategic research. It is essential to recognize that agricultural mitigation of As polluted soils cannot be divorced from sound and efficient water resource management. Institutional adoption of an As-stricken village and putting together available mitigation strategies with hydrologists, agriculturists, livestock and medical researchers may end up with development of a successful model for providing environmental safeguard against As.

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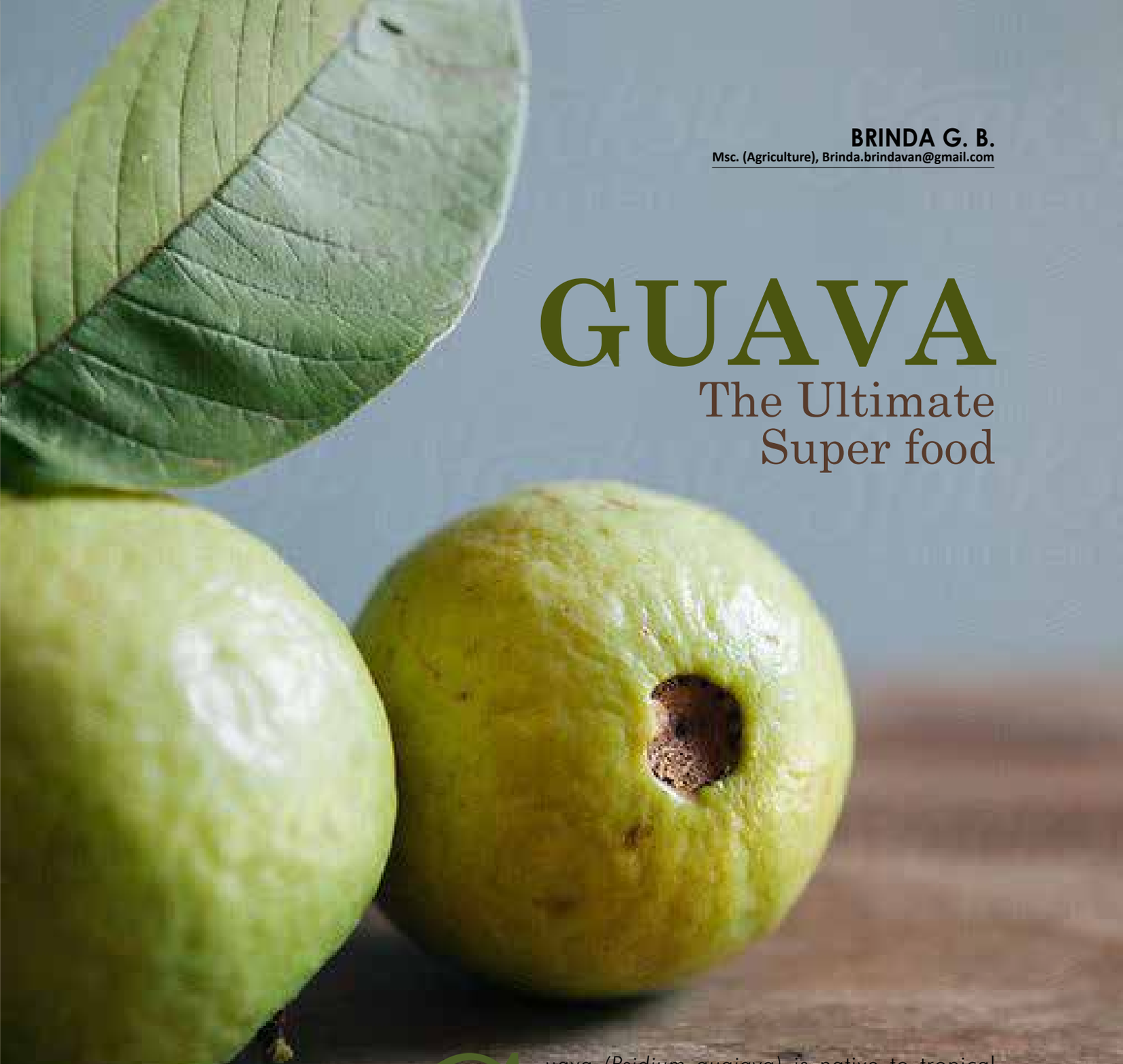
GUAVA
The Ultimate Super food



Guava *(Psidium guajava)* is native to tropical regions like Central and South America, Mexico and the Caribbean. Today, it is grown in warm, tropical climates all over the world. The tree being gregarious and tend to grow easily and freely, often overgrow pastures and fields. Guava fruit, with its unique tropical flavor and taste, is considered as an excellent source of nutrients and antioxidants. Most guavas are green, with slightly bumpy skin, often ripening to a yellow or almost pink color. Ripe guava smells a lot like lemon, its pale pink flesh and juice are sweet and mild. Though the fleshy fruit of the guava plant and the leaves are edible, the fruit most are often eaten as a snack and the leaves commonly boiled into the herbal tea. Guava leaves have many life-saving chemical properties. The leaves are used as a black

NUTRITIONAL COMPOSITION

Many of the powerful health benefits of guava are attributed to its rich nutrient profile. In fact, guavas are low in calories and are loaded with vitamin C, folate, copper, potassium and fibre. 100 grams of guava fruit contains the following nutrients:

Energy	-	68 cal
Carbohydrates	-	14 g
Protein	-	3 g
Fibre	-	5 g
Vitamin C	-	228.3 mg (381% Daily Value)
Vitamin A	-	624 IU (12.5% DV)
Lycopene	-	5.2 mg (52% DV)
Folate	-	49 µg (12.3% DV)
Copper	-	0.2 mg (11.5% DV)
Potassium	-	417 mg (8.8% DV)
Magnesium	-	22 mg (5.5% DV)
Phosphorous	-	40 mg (4% DV)

pigment in the textile industry. Around 150 varieties of Guavas including apple Guava, cherry Guava, strawberry Guava and red-apple Guava can be found in tropical and sub-tropical regions across the globe. The fruit contain around 100-500 miniature seeds which are of edible quality and some varieties have been found to be seedless. It can be eaten raw, as juice, in the form of jellies or in salad. It is one of the least artificially treated fruit.

The fruit is loaded with many essential nutrients. Guavas have been treated as "ultimate superfood" and are widely considered as one of the top antioxidant foods, supplying loads of vitamin C and lycopene in each serving. It is called so because it is said to contain four times more vitamin C than orange and three times more proteins and four times more fibre than pineapple. It is also said to have more potassium than banana.

HEALTH BENEFITS

BOOSTS THE IMMUNE SYSTEM - As guava provides over 350% of the recommended daily value of Vitamin C, it can strengthen the immune system. Vitamin C has long been associated with a healthy immune system, and since guava is bursting with Vitamin C, it is crucial in keeping illnesses at bay.

GOOD FOR DIABETICS - Due to rich fibre content and low glycaemic index, guavas prevent development of diabetes. While the low glycemic index inhibits a sudden spike in sugar levels, the fibre content ensures the well regulation of sugar levels.

LOWERS RISK OF CANCER - Lycopene, quercetin, vitamin C and other polyphenols present in guava act as potent antioxidants which neutralise free radicals generated in our body, preventing the growth of cancer cells. Guava fruit has shown to be widely successful in reducing prostate cancer risk and also inhibit the growth of breast cancer cells since it is rich in lycopene.

REGULATES BLOOD PRESSURE – Guava's inherent high potassium levels naturally lower blood pressure and blood lipids. Potassium is crucial for keeping healthy and strong heart and plays a key role in regulating blood pressure levels.

IMPROVES EYESIGHT - Guava is well known as a booster for vision health due to Vitamin A content. It can help slow down the appearance of cataracts and macular degeneration.

BEATS TOOTHACHE - Guava leaves have potent anti-inflammatory action and powerful antibacterial ability which fights infection and kills germs. Thus, consuming guava leaves works as a fantastic home remedy for tooth-ache. The juice of guava leaves has also been known to cure toothaches, swollen gums and oral ulcers.

TREATS CONSTIPATION – The rich dietary fibre content makes it extremely beneficial for the digestive health. Guava seeds, if ingested whole or chewed, serve as excellent laxatives too, helping in healthy bowel movements.

HELP TREAT DIARRHOEA – The guava leaf extract could be an effective treatment for infectious diarrhoea. It is effective to treat gastrointestinal infections and is successful in part because of the plant's astringency and due to the antimicrobial and antibacterial capabilities of the

plant.

ACT AS AN ANTI-STRESS AGENT

The magnesium in the fruit helps relax our muscles and nerves. Thus it helps to combat stress and provides a good energy boost to our system.

AIDS IN WEIGHT LOSS

Guava regulates body's metabolism and makes us very snak-satisfied. Raw guava have less sugar compared to other fruits and so can be enjoyed anytime of the day.

HELPS DURING COLD AND COUGH

The very high content of vitamin C and iron in guava has proven to prevent from getting a bad cold or any viral infection. The juice from raw guavas is very beneficial in curing cough and cold. It gets rid of the mucus and disinfects the respiratory tract, throat and lungs.

GOOD FOR BRAIN

Guavas contain vitamin B3 (niacin) and vitamin B6 (pyridoxine), which help in improving blood circulation to the brain, stimulating cognitive function and relaxing the nerves.

ANTI-AGEING PROPERTIES - Guavas are rich in vitamins A, C and antioxidants like carotene and lycopene which help protect the skin from wrinkles.

IMPROVES COMPLEXION - Guavas are great source of Vitamin K, which helps to get rid of skin discoloration, dark circles, redness and acne irritation and helps regain the skin's radiance and freshness. It rank high in astringent properties, guava leaves and unripe guavas even higher. It helps tone-up and tighten the facial muscles.

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