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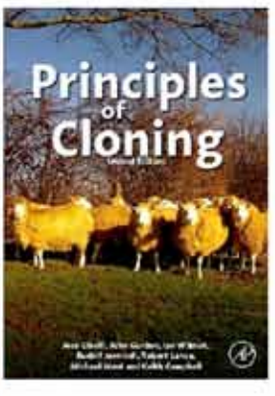
Reaping RICE Reasonably

Strategies for low-cost cultivation of rice



RICE IS LIFE

For more than half of humanity, rice is life. It is the grain that has shaped the cultures, diets and economies of billions of people in Asia. Life without rice is simply unthinkable. Rice is the staple-food for even half of the world's population. It provides 27% of dietary energy supply and 20% of dietary protein intake in the developing world.

Coming to Kerala, rice is the staple-food of Keralites and traditionally the cultivation of rice has occupied pride of place in the agrarian economy of the state. The lush green of paddy fields is one of the most captivating features of features of Kerala's landscape. The area under paddy cultivation increased substantially during the first fifteen years after the state's formation but now a reversal of this trend is seen. There is steady decline in the area and production of paddy in Kerala.

Considering the fact Kerala can't lose its rice fields the elected Government of Kerala is watchful against conservation of paddy fields. Agriculture Minister Shri. V.S. Sunilkumar made clear that the government would not allow reclaiming an inch of agricultural land for any other purpose. Paddy fields has to be protected so as to increase agricultural growth. Steps for initiating paddy cultivation in Rani-Chithira Kayal and Methran Kayal has already been initiated by the State Department of Agriculture. Upland paddy cultivation is also getting more popularity in the present scenario.

As it is said, paddy fields are the blood vessels of the earth. At any cost, we have to protect them for the well-being of both man and nature.

CHIEF EDITOR

INSIDE KERALA KARSHAKAN
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Mail: editorejournalkkfib@gmail.com
Phone: 0471-2314358

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Cover Story

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Enquiries : 0471 2314358

Strategies for Low Cost Cultivation of Rice

Reaping Rice Reasonably

Over the years, rice scientists have developed some tabs and techniques to reduce not only the cost of cultivation but also to enhance long term sustainability of rice cultivation. Ten such tools and techniques are discussed in article.

P. MUTHURAMAN AND P.C. LATHA

Principal Scientist (Agril. Extension) &
Scientist Sr. Scale (Microbiology)
Indian Institute of Rice Research – ICAR
Hyderabad – 500 030
Email: headtttiirr@gmail.com

The major expenditure in rice cultivation involves labor charges related to transplanting, weeding, irrigation and the procurement of plant nutrients, herbicides and other plant protection chemicals. If tool and techniques are developed to overcome these problems, the cost of cultivation can be reduced to the maximum extent. Over the years rice scientists have developed some tools and techniques to reduce not only the cost of cultivation but also to reduce the drudgery and enhance long term sustainability of rice cultivation.

New tools and techniques for low cost rice production

The application of new tools and techniques developed by rice scientists are well acknowledged by the farmers for its potential to bring down the cost of cultivation related to plant nutrients, plant protection chemicals, labor, drudgery, water requirement etc.,

1. Paddy Row Seeder

The manual transplanting involves a lot of human drudgery as the operation is done in bending posture for longer periods. It is essential that the timely transplanting is important to achieve good crop yield. Delayed monsoon forces the farmer to go for planting in short span of time for which the nursery availability becomes a serious constraint. Direct seeding is the often-resorted practice to

Paddy Row Seeder

circumvent these problems. Seed broadcasting often results in no uniform plant stand and difficulty in taking up any intercultural operations thereby affecting the crop yield. Line sowing of the seed would help in optimum plant stand and in taking up weed control which is the common problem associated with direct seeding. To aid row seeding the paddy row seeder is very useful machine in rice cultivation.

The row seeder can be easily operated by a single person to cover an area of about 2 to 2.5 acres in a day in light textured soils. A labor saving to the tune of 33% can be achieved. The machine is commercially available at a cost of Rs.2000/-

The advantages of drum seeder are 1) the machine is simple and can be fabricated in any small workshop, 2) the operation of row seeder is easy and needs no skill, 3) since the sown seeds are partially covered by furrow openers, the menace of bird picking of the seeds is minimized, 4) due to this method the crop matures about 10 days earlier as it eliminates the transplanting shock as experienced in transplanting operation, and 5) the grain yield is almost at par with normal transplanting from the same cultural practices.

2. Green Manure

Green manuring is an arable farming practice in which under composed green material is incorporated into soil in order to increase its immediate productivity. Green manure crops can be leguminous as well as non-leguminous. With the current trend towards the use of organic fertilizers many rice farmers are again looking at green manuring as an economical, practical and even as a pleasing method of restoring soil productivity. Unlike synthetic N fertilizers, legumes utilized as green manures represent potentially renewable source of on-farm biologically fixed N and may also fix and add large amounts of carbon to cropping systems. Green manuring is widely practiced in Andhra Pradesh, Karnataka, Madhya Pradesh, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

There are two types of green manuring practiced by rice farmers i.e., i) green-leaf manuring and ii) green manuring 'in-situ'. Green leaf manuring refers to incorporating into soil the green leaves and tender green twigs collected from the shrubs and trees grown on bunds, waste lands and nearby forest areas. The common shrubs and trees used are glyricidia (*Glyricidia maculata*), sesbania (*Sesbania speciosa*), karanj (*Pongamia pinnata*) etc. This system is prevalent among the rice farmers in eastern, southern and central India. Green manuring 'in-situ' refers to the green manure grown and incorporated in the same field which is to be green manured either as a pure crop or as an inter crop with the main crop.

A vast array of legume species has potential as green manures. Generally, annual legumes such as sesbania, cowpea, blackgram and sunhemp are used for *insitu* green manuring. The most widely used tropical green manure legumes include Crotalaria (sunhemp) Sesbania (dhaincha) Glycine (soybean), Indigofera (indigos), Vigna (cowpea), Cajanus (pigeonpea), Trifolium (Clover), Vicia (vetch) and Medicago (alfalfa). The most utilized green manuring crop, especially before the transplanting of rice crop in India is *Sesbania aculeata*.

For green manure crop to be agronomically attractive and economically viable the plants should have the following characteristics. i) rapid and aggressive initial growth and efficient soil cover ii) produce large amount of biomass, iii) capacity to recycle nutrients, iv) ease of establishment and

management in the field, v) resistance to attacks by pests and diseases and not act as a host, vi) a deep penetrating and well developed root system vii) easy to mange during establishment and during incorporation into the soil, viii) potential for multipurpose use on the farm ix) tolerance or resistance to drought and or cold x) tolerance to low soil fertility and be adapted to degraded soils, xi) ability to produce seed in sufficient quantity to increase area under the crop, xii) not invading and causing difficulties for the succeeding crop and xiii) members of the leguminous family.

The benefits of green manuring in rice are i) building of organic matter and improve soil structure, ii) nitrogen fixation, iii) enhancing soil microbial activity, iv) enhancing availability of native soil nutrients, v) improvement in soil physical properties, vi) benefits of root action, vii) weed suppression, viii) soil and water conservation and ix) enhancing crop yields.

In view of the supply-demand gap in fertilizers, escalating costs, environmental concerns, organic rice farming and sustainability in high productivity zones, green manuring will be perhaps an affordable and adaptable technology by rice farmers.

3. Resistant Varieties

Many times rice farmers inadvertently use particular varieties, which may be very old and not suitable to the given ecosystem. Such type of varieties will also be susceptible to biotic stresses like pests and diseases, abiotic stresses like saline acid sodic and drought and be non-responsive to fertilizers, show lodging, shattering, etc. The selection of rice varieties suitable to the locality based on recommendations of the rice research station or agricultural officials of the state department of agriculture would help to realize the higher yields. Improved rice varieties not only gives higher yield also may possess resistance to both biotic and abiotic stresses which ultimately reduce the use of critical inputs and cost of cultivation per unit area. A list of improved varieties recommended for different ecologies are presented in Table No.1.

4. System of Rice intensification (SRI)

System of Rice intensification is an improved method of rice cultivation which was developed in 1983 in Madagascar and has now spread to many parts of the world. SRI method of cultivation produces higher yields with less seed, less water, less chemical fertilizers and no pesticides but with the use of more organic manures.

The important feature of SRI method are low seed requirement, low water requirement, transplantation of tender / young seedlings (8-12 days), maintaining wider spacing (10 x10 inches or 25 x 25 cm) between plants, keeping the soil both moist and aerated at least during the vegetative growth period, and incorporating weeds in to the soil while weeding, organic manures in place of chemical fertilizers, and pest management without chemicals. Marking the plot before transplantation to ensure proper rows and spacing, and weeding are necessitate development of appropriate implements.

SRI has shown promising results in all the rice varieties – local or improved and hybrids. Rice grown with SRI technology has large root volume, profuse and strong tillers with big panicles, more and well filled spikelets with higher grain weights. Under SRI technique the rice fields are not flooded like conventional fields but only kept moist by alternate wetting and drying. This will save lot of water and the labor charges used for irrigating the field. Since herbicides are not recommended under SRI method this not only save the cost of herbicides also protect the soil microorganisms which will uphold the soil fertility status.

By adopting SRI method of rice cultivation the farmers accrues the following benefits viz., higher grain and straw yields per unit of land cultivated, reduction in crop growth duration by ten days, lesser chemical inputs, fewer pests and diseases attacks, seed savings, less water requirement (about half that of the conventional method), less chaffy grain, grain weight increased without change in grain size, higher head rice recovery, crop can withstand in both drought and cyclonic conditions, soil health improves through biological activity, increased factor productivity, rice plant is tolerant to cold condition and increased income for farmers and reduced risks.

By adopting SRI method of rice cultivation, lot of money can be saved in nursery preparation (68%) and weed management (53%) but on the whole, amount of money earned by adopting SRI cultivation 13% in one hectare of land and hence more money can be earned by adopting STRI in larger areas. Yield wise also, SRI cultivation yields 7.1t/ha compared to 6.7t/ha by conventional

method. Gross returns from SRI cultivation is Rs. 39050/- from a hectare of SRI field compared to Rs. 36850/- and the benefit cost ratio in case of SRI is compared to 1.73:1 in conventional rice cultivation. These clearly show that SRI cultivation methodology is better than the conventional rice production technology.

Therefore, it can be effectively used for increasing rice production, along with the judicious use of the resources available with us, thereby reducing the total cost incurred in the process.

5. Aerobic Rice

Aerobic Rice Cultivation

Aerobic rice different from the conventional upland rice, it is high yielding, grown by direct seeding or transplanting with high inputs and is responsive to the external inputs. Aerobic rice is a new concept of growing rice: it is high-yielding rice grown in non puddled, aerobic soils under irrigation and high external inputs. Studies suggested that compared to lowland rice, water inputs in aerobic rice were more than 50 percent lower (only 470-650mm), water productivities 64-88 per cent higher, gross returns 28- 44 per cent lower, and labor use 55 per cent lower. Because of its low water use, aerobic rice can be grown in water short areas where lowland, rice cannot be grown anymore.

Several systems are being researched and have the potential to successfully grow aerobic rice to replace puddling in rice fields. Some important systems are 1) dry seeded rice, 2) zero till rice and 3) raised bed planting rice.

Under dry seeded rice, it is grown like any other upland crop with seeds placed in soil with or without ploughing. Besides providing better yield, this system saves water. But weed problem is much exaggerated in this system, which is difficult to control. In zero till rice, weeds are allowed to germinate and then controlled with non-selective herbicide. A zero till drill is then used to seed rice. Because soil is least disturbed in this method, fewer weeds germinate. Raised bed planting rice method is more useful in case of hybrid rice cultivation. Here, raised beds are prepared for afresh or the beds prepared for the previous crop are used for seeding. Weeds are still a problem and need integrated management to control them.

Advantages of Aerobic Rice Cultivation

Saving water is the main advantage of this system. As compared to conventional system, there is a saving of at least 30 – 50 per cent water. Bed planting makes fertilizer placement, wedding and spraying easy. Though comparison between aerobic rice and flooded lowland anaerobic rice is interesting from an agronomic point of view, socio-economic comparison must be taken into account. In comparison to lowland rice, more than 50 per cent less labor is required in growing aerobic rice because of the absence of puddling and transplanting. Due to less frequent irrigation applications, the labor associated with irrigation is also smaller in aerobic rice.

6. Biofertilizers

Biofertilizers are inputs containing microorganisms, which are capable of mobilizing nutritive elements from non-useable form to usable form through biological processes. They

are low cost, eco-friendly and sustainable, do not require non-renewable source of energy during their production and improve growth and quality of crops by producing plant hormones and vitamins etc., to supplement chemical fertilizers. They improve soil properties and sustain soil fertility. They help in mineralization of plant nutrients. The beneficial microbes in the soil which are of great significance to rice crop are the nitrogen fixers and phosphate solubilizers. The suitable strains of micro-organisms may also be used for decomposition of organic wastes for use as organic manure in agriculture. These include specific strains of bacteria, fungi and algae.

Biofertilizer components of Integrated Plant Nutrients system (IPNS) in rice

a) ***Azolla***: A floating fresh water fern with ubiquitous in distribution in low land fields and water bodies, azolla harbours a nitrogen fixing cynobacterium (BGA) called Anabaena *azollae* at all stages of its growth and development. Azolla has very fast growing character; it doubles its biomass in three to five days and fixes 40 to 60 N kg /hectare. Normally one kg *Azolla* can fix 1.9 to 2.5 kg nitrogen in about one month optimum growth conditions.

b) ***Blue –Green Algae*** (BGA), also known as cynobacteria, are photosynthetic nitrogen fixing bacteria and lowland (puddled) rice is an ideal ecosystem for their survival, growth and nitrogen fixation. The BGA promotes the growth of rice crop by supplying fixed nitrogen through exudation and microbial degradation of dead algal cells. Basically BGA is a photosynthetic nitrogen-fixing agent. Various studies conducted by the rice scientists have shown that BGA can fix about 20-30 kg N/ ha/season. Application of 10 kg BGA culture in rice can increase the yield upto 15% under optimum conditions.

c) ***Azospirillum*** is an associative symbiotic nitrogen fixing bacterium found to be associated with the root system of many grasses. It helps to save up to 20 kg N/ha and promotes better vegetative growth as it produces indole acetic acid (IAA), gibberellins and cytokinin when inoculated to rice which in turn result in increased root development. Its inoculation helps in maintaining soil fertility.

d) **Phosphate soluble microorganisms** are a group of diverse heterotrophic /autotrophic microorganisms capable of solublilizing / mineralizing insoluble sources of phosphorus to plant available forms. They may be bacteria like *Bacillus megatherium*, *B. polymyxa, Pseudomonas striata, P. fluorescens,* fungi like *Aspergillus awamori, A. niger*, and *Trichoderma*. They increase the availability of native soil P by solubilization of insoluble inorganic P by the production of organic acids and mineralization of organic P by production of phosphatases. Inoculations with phosphate solubilizing microorganisms are reported to increase yield, P uptake and soil available P.

7. Leaf Color Chart

Nitrogen (N) fertilizers are the costliest amongst the inputs of rice cultivation. Due to losses like leaching, volatilization and denitrification, the recovery efficiency of applied N fertilizers seldom exceeds 50 per cent. To reduce the losses and to increase recovery efficiency of N, several agronomic approaches such as split application, controlled irrigation, use of nitrification and urease inhibitors and slow release N fertilizers have been developed over the years. All these techniques provide only limited success. In this direction, recently a plant health indicator popularly known as Leaf Color Chart (LCC) has been developed and found to be an ideal tool to optimize N use in rice cropping, irrespective of the source of nitrogen applied - inorganic, organic, and biofertilizers. The LCC is easy to use and inexpensive (costing only 20 rupees per chart), simple and useful tool in determining right time and dose of N application and helpful in avoiding excess use of N.

Based on International Rice Research Institute (IRRI)'s and All India Coordinated Rice Improvement Project (AICRIP)'s results, LCC have been developed and popularized through Crop Resources Management Network (CREMNET) to help rice farmers. The LCC evaluates N status of rice crop cost-effectively. With this technique, leaf nitrogen content can be estimated at specific stages of plant growth by comparing leaf greenness with a leaf colour chart. In this way, it gives farmers an idea as when to apply fertilizer and how much is needed. The concept of LCC is based on the research results that show a close link between chlorophyll and N content of leaf. The LCC contains different gradients of green colour from yellowish green to dark green based on the wavelength characteristics

Resistant Varieties against both biotic and abiotic stresses

Table I. Insect Pests

Sl. No	Insect pests	Resistant Varieties
1	Gall midge	Sneha,Pothana, Kakatiya, Erramallelu, kavya, Rajendradhan 202, karna, Ruchi, Samridhi, usha, Asha, MDU 3, Bhuban, Samalei, Orugallu, Abhaya, Shakthi, Suraksha, Daya, pratap, Udaya, IR 36, Shathiman, Tara, Kshira, Sarasa, Neela, Lalat, Phalguna, Mahaveer, Vibhava, Divya, Dhanya lakshmi, Surekha, Vikram, Kunti, Triguna
2	Brown planthopper	Chaitanya, Krishnaveni, Vajram, Pratibha, Mekom, Pavizham, Manasarovar, Co-42, Chandana, nagarjuna, Sonasali, Rashmi, Jyothi, Bhadra, Neela Annanga, Daya, Aruna, Kanaka, Remya, Bharathidasan, karthika, Vijetham Cotton Dora Sannalu
3	Whitebacked planthopper	HKR 120, HKR 126
4	Green leafhopper	Vikaramarya, Lalat, Nidhi
5	Stem borer	Ratna, Sasyasree, Vikas

Table II. Diseases

a. Fungal Diseases		
1	Blast	Rasi, IR 36, IR 64, Sasyasree, Srinivas, Tikkana, Simhapuri, Parijatha, Salivahana, Gauthami
2	Sheath blight	Swarnadhan, Vikramarya, Radha, Pankaj, Manasarovar
3	Sheath rot	Bala, Cauvery, Kakatiya, Janaki, Tella Hamsa, Sabarmati, Swrnadhan, Vikas, Rajavadlu, Phalguna, Vikramarya,
4	False smut	Bala, Cauvery,Sabarmati, Prakash and Pankaj
5	Brown spot	Rasi, Jagannath, IR 36
6	Stem rot	Jagannath, Sabarmati, Pankaj, Govind, Jalmagna
b. Bacterial Diseases		
1.	Bacterial blight	Ajaya, IR 64, Sona Mahsuri, Swarna
c. Viral Disease		
1	Tungro	Vikramarya, Nidhi, Radha, Annapurna Triveni

III. For Abiotic Stresses

1	Saline soil	CSR 10, CSR 13, CSR 27, CSR 30. Vikas, CST 7-1, Lunishree, Panvel-3, Panvel-2,
2	Coastal saline soil	Vytilla-2, Vytilla-3, and Vytilla -4
3	Inland saline soil	Panvel 3, Panvel 2, CSR 10, CSR 13, CSR 27, CSR 30, Vagadhan, VL Dhan 16, VL Dhan 163, Pantdhan 16, Vaigai, MDU 1, PMK (R) 3, Tulasi, Heera, Rasi, Annada
4	Deep water	Eriema phou, Neeraja, Jalapriya, Jalaprabha, Jitendra, Sunil
5	Upland	Narendra Dhan 97, Narendra Dhan 18
6	Cold	VL Dhan 221, Majhera, Pantdhan 11

of rice leaves, and can guide N top dressing. It has 6 color shades ranging from yellowish green (1) to dark green (6) and holder in grey color. In rice, observations start at 14 days after transplanting or 21 days after sowing and the last reading is taken at flowering. Ten leaves are selected and readings are taken at 7-10 days interval (early tillering, active tillering, panicle initiation and first flowering). On appearance of deficiency symptoms, about 20-30 kg N / ha is applied for wet season or low yielding season and 30-35 kg/ha for dry season at each stage. It results in savings of 8 - 22 kg/ha, and yield increase about 2 - 8%. More than 4.0 million rice farmers are using the LCC for real time N management in different Asian countries including 10000 in India.

Thus, LCC can be used as quick and reliable tool for assessment of N leaf status of crops at different growth stages. Thus farmers can use leaf colour as a visual and subjective indicator of the

rice crop's N status and decide about the need for N fertilizer application. Since it is cost effective the small and marginal rice farmers can afford it.

The successful adoption of the LCC will promote timely and efficient use of N fertilizer in rice and minimize environmental pollution.

8. Trap crops

The utilization of trap crops for pest and disease control had been very successful in rice cultivation. In rice pest control, trap crops are species of rice plants which are highly susceptible to a insect pest of a primary crop and are planted so as to be attacked by the insects at an appropriate time, and both the trap crop and insect pest are then destroyed in single operation, leaving the primary crop relatively free from attack by the insects. The trap crop attracts the insect pests as effective lures. The plants preferred by the insects are planted between rows of the crop or at the field edges and the trap plants, when infested, are collected and destroyed or left to prevent the crop from being attacked. Alternatively, the insect pests concentrated at particular small areas of a field by trap crops can be destroyed with locally applied insecticides. The principle of trap cropping had been particularly successful in control of the insect pests of leaf folder and yellow stem borer in rice.

The trap crop technique relies on the attraction of insect pests to plantings other than the main crop. Timing is important in utilizing a trap crop, as the pests should not be allowed to reproduce. A trap crop should not sacrifice field area.

Rice entomologists are using the trap crop technique to control stem borers by planting many small fields comprising 0.7 to 5.0% of the rice area ahead of the main crop and increasing their attraction by using susceptible cultivars, high amount of nitrogen and lights. It is important to plant a trap crop over an area large enough to attract the resident pests.

Another successful method in trap crop technique was to delay the land preparation of the weedy fallow until after emerging green leafhopper and small brown planthopper adults laid eggs. This method requires perfect timing. Leaving small patches of weeds to attract seed bugs also has been used. The patches are frequently sprayed with insecticide while fields are thoroughly weeded.

Another technique of trap crop is to plant highly susceptible cultivars to attract stem borers, brown planthoppers or green leafhoppers. The border areas are then sprayed. The problems with earlier plantings are that more extended water delivery is required; the pest free fallow period is reduced. Research carried out in DRR experimental fields proved that fields with a trap crop planted 20 days ahead of main crop, attracted more *N. lugens* and *N. virescens*, gave significantly higher yields, and preserved more natural enemies than controlled fields without trap crop.

Pheromone Traps

9. Pheromone Traps

A pheromone is a chemical messenger produced naturally by an organism and released into the environment. When detected by a second individual of the same species, the pheromone changes the behavior of that second individual. A sex pheromone is used to help one sex (typically the male in insects) orient toward and find the other sex for mating. Sex pheromones can be detected over hundreds of yards on wind currents, and by flying upwind in the pheromone plume, the male can almost always find the female.

Among the many alternatives to control insect pests of rice, sex pheromones are considered to be cost effective, environmental friendly and easy to adopt. Sex pheromones which are involved in species communication to find mates could be exploited for managing yellow stem borer (YSB) in rice. Pheromone traps can be used for monitoring

the pest population, aiding in decision making for chemical interventions. They can also be used as direct control tools through male annihilation technique involving mass trapping of males or mating disruptions involving mass trapping of males mating disrupting involving permeation of fields with pheromones. This is also compatible with other components of IPM in rice.

Advantages of pheromone-based pest management systems

- Negligible health risks to applicator and consumer.
- Virtually no detectable residues for some types of dispensing systems.
- No accumulation in groundwater or wildlife.
- Strong tool for managing insecticide resistance to other pesticides and no documented cases of resistance to the pheromone itself.
- Highly selective to the pest species being targeted for disruption without causing secondary pest outbreaks due to the elimination of biological control agents. This selectivity creates opportunities for the biological control of other pest species. Nontarget effects are generally not seen within or outside of the treated field.

10. Cono-weeder

Manual weeding requires an average of 120 person-hours to weed one hectare while conventional weeders require 80-90 person hours. These weeders are difficult to push and must be moved back and forth for proper operation.

Cono-weeder is a mechanical device to control weeds in rice fields. This tool comprising a long handle to push a conical rotor to trample the weeds in between the paddy rows. It can be operated in the fields where line planting or sowing with a minimum row to row spacing of 20 cm, or crop established through system of rice intensification method. In cono-weeders the conical shaped rotors uproot and bury weeds. It weeds effectively in a single pass. This is due to the horizontal back and forth movement in the top 3 cm of the soil layer, where most of the weeds grow. This will provide mulching effect also the weeds can be incorporated in to the soil. Power requirements are low, as only a small quantity of soil is worked during weeding. Cono-weeder is about twice as fast to operate compared to conventional rotory weeders and can be easily operated by women and children. With four cono-weeders, one acre can be weeded in a day. The cost of the equipment is Rs.750.

The guiding principles of cono-weeders are need to have built in width adjustability, to have an arrangement to avoid mud getting stuck between the teeth/ blades, to be fitted with a guard to protect rice plants while weeding, to be simple in design so that it can be manufactured locally and sold at an affordable cost, to be all weather proof and durable, to be available in multiple designs/ models so that SRI farmers have options and need innovative designs in reducing the walking distance.

The farmers adopted SRI method of rice cultivation prefer to use cono-weeder to do the inter-cultural operations because it is easy to operate, adjustable, portable and its low cost and efficient weeding. The other perceived advantages are that it controls weed, green manuring due to incorporation of weeds into soil, soil aeration, increased soil biological activity and increased nutrient availability and uptake.

Despite the cost effectiveness, drudgery reduction and long term sustainability all the technological options discussed in this article may not be possible for the farmers to adopt in toto, due to various reasons like the availability, affordability, compatibility and the knowledge level of the farmers. But all the technologies have inbuilt capacity to reduce the cost of cultivation. Each technological option can bring down the cost of cultivation to the extent of 5-10%. Resistant variety is one such technological option where every farmer can afford and benefit out of it. In the labor scarcity areas, farmers can opt for drum seeder and cono-weeder for crop establishment and intercultural operations to carry out the work in time with precision. In problematic soil, farmers can opt for green manure and biofertilizers. Use of green manure, biofertilizers and leaf color chart can reduce the cost of fertilizer also protect the rice soil from degradation. In water scarcity areas farmers can go for SRI method of rice cultivation and aerobic rice. In yellow stem borer endemic areas the available technological options are using pheromone traps and trap cropping with Pusa basmati. Wherever possible, farmers can adopt the maximum number of technologies so as to bring down the cost of cultivation, drudgery and to enhance the long-term sustainability.

Rice can be a Medicine!

if we conserve them..!!

At present the cultivation of traditional rice varieties is restricted in tribal hamlets and among the farmers who value the importance of these genetic resources. To encourage *in-situ* conservation of existing land races, the State needs to pitch in with favourable policy environment aimed at incentivising conservation, protection of their rights over resources, and provide infrastructure and market support.

GIRIGAN GOPI AND MANJULA M

Principal Scientist, M.S. Swaminathan Research Foundation, Kalpetta, Wayanad.
Email: girigan@mssrf.res.in

Rice protein has high nutritional value (Chaudhary and Tran, 2001). It is not only the source of rich source of nutrition for human beings but also possess lots of medicinal properties. People in rice growing countries have recognized the medicinal and health benefits of rice grown in their region. In Philippines, rice bran is traditionally used to cure beriberi and other disorders occurring due to lack of Vitamin B. In Malasia, rice is suggested as a medicine to cure inflammation of the inner body. China has a rice and long tradition of using rice as medicine. Chinese healers in the

past believed that rice has the capacity to restore tranquility and peace to those who were easily upset. Dried, sprouted rice grains were used to aid indigestion and expel gas from the stomach and intestines. The Chinese believe rice strengthens the spleen as well as stomach, increases appetite, and cures indigestion. They use red rice yeast for various ailments.

Medicinal values of certain rice varieties have been documented in ancient Indian books on medicines such as in the *Charaka Samhita* (c. 700 BC) and the *Susruta Samhita* (c. 400 BC), in the treatment of various ailments such as diarrhea, vomiting, fever, hemorrhage, chest pain, wounds, and burns. Traditional healers, even today, suggest rice as medicine for skin diseases, blood pressure, fever, paralysis, rheumatism, and leucorrhea, as well as a health tonic and for lactation in lactating mother.

In countries like India and China, rice is used to cure many ailments including preventing dysentery, stomach disorder, rejuvenating health, post natal care *etc.* Rice is the main constituent of life-saving oral rehydration solutions (ORS), and has been used for this purpose since time immemorial.

Medicinal rice varieties

Several of the ethnic health care practices use rice varieties with specific medicinal properties. The communities involved in ethnic healthcare have been conserving these varieties over generations. Susrutha (ancient Indian book on medicine) and other Ayurvedic literature testify the medicinal and curative properties of different types of rice grown in India. *Kanthi Banko* (Chhattisgarh), *Meher, Saraiphul, Danwar* (Orissa), *Atikaya, Kari Bhatta* (Karnataka) and *Njavara* (Kerala) are the most common medicinal rice varieties found in India. According to Susrutha, rice can be broadly classified in to two, saali and vreehi. Saali rice varieties are characterized by red husk, white kernels, and are mostly grown during the winter season. *Vreehi* rice varieties have different husk colours with red kernels and are grown during the rainy season.

Medicinal rice varieties of Kerala like *Chennellu, Chembavu, Erumakkari, Kalamappari, Kunjinellu, Narikari, Neduvali, Poovali, Janavala, Varakan,*and *Velval,* are believed to be Saali varieties having medicinal value. Varieties like *"Navara (Navara), Karimkuruva, Perunellu, Uliamkathi, Valanellu, Chitteni, Modan, and Aarunellu,"* are some of the important vreehi varieties which were in existence in Kerala (Nair, 2004). Anoori is a rice variety used by the Kani tribes as medicine for the treatment of small pox. *Kunjinellu* is indigenous to North Kerala. *Kunjinellu* is advised to patients recovering from jaundice. *Chennellu* is advised as a medicine for the treatment of diarrhoea and vomiting. *Erumakkari* and *Karuthachembavu* are the medicinal rice varieties indigenous to South Kerala. *Karuthachambavu* has black grains with blackish red kernels. The gruel made by the poached grains of *Karuthachambavu* is used to treat nausea, vomiting and stomach pains. *Erumakkari* is used for treatment of cough. Table 1 shows the indigenous medicinal rice varieties cultivated in different parts of Kerala and their uses.

Most of the medicinal rice varieties other than *Njavara* are confined to certain districts and their surroundings only. *Njavara* is the most popular medicinal rice variety in Kerala. Because of its popularity and wide range of uses, *Njavara* has been cultivated across the State. Most of these rice varieties either extinct or on the verge of extinction. Reduced dependence on traditional healthcare systems, lack of awareness about the quality and value of medicinal rice varieties, conversion of rice fields for other purposes, state supported promotional activities for High Yield Verities *etc.,* pose threat to the conservation of traditional rice varieties in general and medicinal varieties in particular.

Table **Indigenous Medicinal Rice Varieties of Kerala**

Name	Place of Cultivation	Medicinal uses	Remarks
Erumakkari	Ernakulam, Trissur	Treatment of cough and respiratory disorders	Up land rice. Used to cultivate in coconut gardens.
Jaatthisughi	Kasargode,	Anti-dysenteric properties Suggested to lactating mother to rejuvenate health	Highly preferred variety for consumption as well as medicinal purposes.
Jeerakachembav	Thiruvananthapuram	Anti-dysenteric properties Control vomiting and stomach ache	Very small and slender grains; kernel white highly preferred for consumption
Anoori	Thiruvananthapuram	Treatment of small pox	Wild rice variety - Conserved by the *Kani* tribes
Karuthachembav	Thiruvananthapuram	Gruel made by the poached grains of *Karuthachembavu* is used to treat nausea, vomiting and stomach ache	Grain is black in colour Used as a substitute of *Navara* (a medicinal rice)
Kolaran	Kasargode	Recovering health of patients and lactating mother	Dark purple grains. Used in place of *Navara* if it is not available.
Kunjinellu	Kannur	Patients recovering from jaundice	Upland rice; scented, highly preferred for consumption for health rejuvenation.
Nallachennellu *Naron*	Kannur Kannur	Treatment of diarrhoea and vomiting Rejuvenating health. Used as a substitute of navara in Ayurvedic treatment	Kernal red rice flakes are medicinal Up land rice.
Navara	Across Kerala	Widely used in Ayrvedic treatment for Arthritis, muscle degeneration, cervic spondylitis, burnings, dyspepsia, bilious fever, and diabetes. Regular consumption of this variety helps the growth of muscles, maintaining youthfulness and longevity	All season crop. Up land and medium low land. Widely known as medicinal. Employed in Ayurveda.
Vatton	Trissur, Palakkad and Malappuram	Rejuvenating health – Anti-dysenteric	Very similar to Navara but grains are slightly bold. Used in place of *Navara*
Kavunginputhala	Palakkad	Recommended for diabetic patients	

Sources: Primary data; Compiled from published and unpublished reports

Status of traditional rice varieties in Kerala

Leena Kumari (undated) stated that there were about two thousand traditional rice varieties, predominantly cultivated in Kerala. These varieties were suitable for different agro-climatic situations and seasons of rice cultivations. In 1976, Kerala Agricultural University collected over 1000 traditional rice varieties from different parts of the State. A study conducted by M.S. Swaminathan Research Foundation (Anon, 2001) in Wayanad shows that there were more than 75 traditional rice varieties cultivated in Wayanad before the advent of commercial agriculture. This came down to just 21 varieties in the year 2000. Advent of input-intensive agriculture and consequent widespread adoption of High Yielding Varieties (HYV) displaced a large number of traditional rice varieties in Kerala. At present, the cultivation of traditional rice varieties is confined to marginal land and in the tribal areas.

Palakkad district leads in terms of area under traditional rice varieties with coverage of 3453 ha

in 2010-11. Other major districts are Malappuram (2387 ha) and Kozhikode (2163 ha). Even though the area under rice cultivation is comparatively less, majority of the farmers in Kozhikodu district prefer cultivating traditional varieties. In Kozhikodu, spread of HYVs is restricted to just 840 ha, that is around 27.9 per cent of the total rice area in the District. The area under HYVs in total rice area is high in Pathanamthitta (99.7%), Kottayam (99.6%), Alappuzha (98.9%) and Thiruvananthapuram (97.1%) respectively. In southern region, Kollam district has maximum area under traditional rice varieties. Traditional rice varieties occupy 28.2 percent of the total rice area in Kollam district.

Farmers in the Malabar region prefer to cultivate traditional rice varieties compared to rest of the State. Altogether, 7 districts in the northern region contribute 86 per cent of the total area under traditional rice varieties in the Sate. Of these, Palakkad, Malappuram and Kozhikode together account for more than 53 per cent of the traditional rice variety area. Figure 2 explains the contributions of northern districts in the total traditional rice varieties area.

Conservation challenges

At present the cultivation of traditional rice varieties is restricted in tribal hamlets and among the farmers who value the importance of these genetic resources. To encourage *in-situ* conservation of existing land races, the State needs to pitch in with favourable policy environment aimed at incentivising conservation, protection of their rights over resources, and provide infrastructure and market support. Current legal framework for ensuring conservation of paddy lands in Kerala has not yet proved effective as it is evident from the continuous decline in area under rice cultivation. Similarly the provisions under *'The Protection of Plant Varieties and Farmers' Rights Act,* implemented by the Government of India is yet to reach farmers who conserve our plant genetic resources (public goods) at their personal cost.

References

Anon (2001) *'Phase I Completion Report on Conservation, Enhancement and Sustainable and Equitable Use of Biodiversity',* Submitted to the Swiss Agency for Development and Cooperation, M.S. Swaminathan Research Foundation, Chennai, India.

Chaudhary RC and Tran DV.(2001). *Specialty rices of the world – a prologue. In: Specialty Rices of the World: Breeding, Production, and Marketing* (Chaudhary RC and Tran DV, eds.). FAO, Rome, Italy; and Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India. pp. 3–14.

Leena Kumari, S. (undated) *Status Paper on Rice in Kerala* Accessed from http://www.rkmp.co.in/sites/default/files/ris/rice-statewise Status Paper on Rice in Kerala.pdf

Management of Water for Rice

High Water use Efficiency in Rice

Dr. KAMALAM JOSEPH

Scientist F (Retd.), CWRDM, Calicut
Email: kamalamjoseph@yahoo.co.in

Rice is a water loving plant. Water management for rice involves all the management practices needed for keeping water at a favourable level in the field, by way of removing salinity, acidity, salt toxicity *etc*., and also for pest and disease control. Hence, both irrigation and drainage form part of water management practices. For adopting efficient water management in rice, it is essential to have a correct understanding of the water losses from the field, water requirement of the plant, water needs for cultural practices and problem alleviation *etc*. Water requirement for a successful rice crop varies with the method of land preparation, method of crop establishment, duration of the crop, soil type, environmental conditions and management of the subsequent crop.

Water loss from rice fields

Water is lost through evaporation (E) from the free water surface, transpiration (T) from the crop, seepage (S) and percolation (P) of the soil, bund breakages and runoff from the field. S and P vary with the edaphic environment and can be partially controlled through proper management. Evapo-transpiration (ET) depends mainly on vapour pressure deficit and canopy size and hence is beyond the farmer's control. Bund leakages and run off from the field are totally under farmer's control. Seepage and percolation vary with soil type, topography and depth to groundwater table and farming practices. S and P values have been mostly assumed as 2-4 mm/day. This can be as high as 10mm/day in less suitable soils. While seepage has certain advantages such as removal of toxic substances and supply of oxygen to the roots, excessive seepage results in wastage of water, leaching of plant nutrients, water logging and soil salinity.

Water requirement of rice

In wetland paddy fields, since standing water is the rule, conditions that prevail are entirely different from uplands. Rainfall including runoff from uplands and irrigation are the major source of water in wetlands. Standing water is lost mainly through evaporation, seepage, percolation, surface runoff and crop uptake. The average water requirement for medium duration rice (transplanted) in the main field can be considered as follows:

- Puddling and leveling :200-300mm
- Evaporation and transpiration :350-700mm
- Seepage and percolation loss :300-1000 mm
- Total :850-2000 mm

This wide range of water requirement is mainly due to the variation in soils and growth duration of different varieties. Water requirement

for land preparation of a wetland crop is determined by the amount required for soil soaking, losses during operations and maintaining standing water in the field. Initially about 100-150 mm of water will be essential to soak the soil for first ploughing. The remaining water is then applied in one or two installments to complete puddling and leveling and to keep the required depth of standing water at the time of transplanting. About 100-200mm of water can be saved by preparing the land expeditiously. Water requirement for soaking the land which depends on the initial soil moisture content and surface conditions of the land and soil type may vary from 30mm to 125mm as there may be losses though cracks and other ways.

Heavy soils lose less water (about 300 mm) by seepage and deep percolation compared to other soil types. Light sandy soils have the maximum loss (about 1000 mm). Hence medium to heavy soils are best suited for paddy. Water requirement will be the highest in the *punja* (December-March) season, during which time, temperature will be more and water table will be low. Similarly, longer the duration, more will be the water requirement.

Water management in rice nursery

The total water requirement of the nursery is the water required to prepare the nursery site and the water required to maintain a thin film during the seedling growth. Once the land preparation starts, soil should not be allowed to dry. At the time of seeding, only a thin film of water should be there in the nursery and subsequent irrigation is necessary only when the standing water is completely withdrawn. Thereafter the standing water can be gradually raised to 2 cm as the seedlings grow in height. The total water requirement comes to 40-60 cm. Drain the field occasionally to encourage the production of vigorous seedlings with short roots. Flooding the soil with too much water for long period results in the production of tall and weak seedlings.

Water management in main field

At the time of transplanting, the field should be perfectly level and there should be 1-2 cm of standing water. The first irrigation after transplanting need be given only after this water dries up. In the case of direct sown crop, at the time of broadcasting there should only be a thin film of water in the main field. Water management in rice is closely associated with growth phases of the plant. At about 30 days after transplanting, the plants attain maximum tillering stage. At about 70-80 days, ear heads emerge and 30-40 days after that the paddy will reach harvesting stage.

Water requirement for paddy is the highest during the active vegetative phase of the plants. This is the period when tillers are profusely produced. During this period, 5-10 cm standing water has to be maintained in the field. This will help in reducing weed infestation also. When the water is more deep than optimum, tillering is reduced, which will adversely affect the yield.

Loss of water from the set level in the field due to evapo-transpiration, seepage and percolation is made good mainly through rain or irrigation water. That part of rainfall which makes up the loss of water level in the field is termed as Effective Rainfall. Thus the amount of effective rainfall directly contributes to the irrigation need of the crop. Rainwater can be harnessed in field channels. Hence channel to field irrigation is to be practiced instead of field to field irrigation. At 50% ripening of grains or at about 15 days before harvest, water should be drained out of the field. This will facilitate uniform maturing of the grains and easy harvest operation.

In areas where water for irrigation is assured and where acidity is high draining and re-flooding every 15 days is recommended. At the time of fertilizer top dressing and plant protection measures water will have to be drained from the field as per the scientific recommendations given for the practice.

Effect of water deficit

An understanding of the effect of water-stress on rice will help to scientifically plan the operation plan and irrigation scheduling. Response of rice plant to water stress varies with growth stage and other agronomic practices. Effect of water stress may vary with the variety, degree and duration of water stress and the growth stage of rice crop. Water requirement is low at the seedling stage. Unless there is severe water stress, the effect during this stage could be recovered. Water stress during vegetative stage reduces plant height, tiller number and leaf area. The effect varies with sensitivity of stress and the age of crop. Water stress during leaf expansion period decreases leaf area which reduces the intercepted solar radiation. Therefore many scientists have reported that maintaining saturated

water regime throughout the crop duration is best for saving water and increasing grain yield. However, if the weed-pressure is high, maintaining standing water until the closure of canopy and then maintaining saturated soil conditions could increase water saving without reduction in yield. Soil cracking should be prevented to reduce percolation during subsequent irrigation.

Rice is most susceptible to water stress during reproductive stage. Water stress at or before panicle initiation reduces panicle number considerably, but all stresses regardless of crop stage or duration significantly reduce panicle number. Water stress after panicle initiation reduces the potential spikelet number. Water stress during anthesis increases the proportion of unfilled spikelets. Mild stress affects sink more than source, whereas severe stress affects both. Stress during grain filling decreases translocation of assimilates to the grain which decreases grain weight and increases empty grains. Chances of recovery of a rice plant after relieving drought stress vary with the variety, the severity of stress and growth stage. Based on the above characters, water management should be planned to achieve the maximum water use efficiency.

Common irrigation practices

In the rice fields, water is given continuously or occasionally depending on the convenience.

Continuous submergence

Irrigation requirement under continuous submergence varies a great deal among the regions and locations based on the ecological characteristics, particularly soil type and the seasonal rainfall. Considerable loss is reported under this system.

Rotational submergence

Instead of keeping the field flooded continuously, soil is irrigated, allowed to nearly dry out, and then irrigated again, with the process repeated through harvest. There are enough evidences that rotational submergence is as effective as continuous submergence, saving irrigation water with comparable yield. There are differences stating that an extended period of drainage in vertisols may not save water, rather it may accentuate seepage and percolation loss when the dried and cracked soil is re-irrigated. Under high weed pressure, shallow flooding (2.5 cm) during the first 45 days after transplanting followed by maintenance of a saturated regime for the rest of the season resulted in similar yields but with a 30% saving in water over the flooded regime. Rotational irrigation systems can be used where there are good irrigation water control and distribution systems and excellent farmer cooperation.

Occasional submergence

In occasional submergence system, there are options for flooding during critical stages and thus to minimize the total water demand. Water is applied to the rice fields to ensure submergence during selected periods of rice growth which are critical from the stand point of management and productivity. The fields can be flooded to create medium depth of submergence depending on the crop growth stage during the rest of the growing period.

Measures for increasing water use efficiency

It is advisable to develop and follow effective measures for minimizing water needs in rice cultivation. The growing water shortage calls for addressing the pressing need to devise methods for growing rice with less water, without any penalty to production. The measures include adoption of suitable cultural practices, rainwater harvesting,

adoption of water saving irrigation methods *etc*. and these are discussed in brief below:

Selection of varieties

Selection of a particular duration class to suit the available water would increase the field irrigation water use efficiency. In general, lowering the duration decreases the water requirement for paddy but at the expense of yield. Cost of land preparation and other agronomic practices would be the same or higher except a small decrease in use of fertilizers and pesticides with short duration varieties. However, short growing season demands better weed control and optimum timing of operations which could increase the cost of production. Very short duration (75 days) varieties can be used in drought prone areas to avoid terminal drought but potential yield of such varieties are rather low. By growing an early maturing variety of 75 days in place of variety with 100 days duration, there will be net water saving of 200-350mm. These varieties can be used as an escape mechanism.

Maximising Rainwater Utilization

The potential of available rainfall for growing rice is under utilized. An appropriate technology package has to be developed for maximizing its utilization. This will involve a detailed analysis of temporal distribution of growing season rainfall and planning of interventions to maximize rain water utilization. An optimum technology to suit different situations will have to be evolved.

Wet seeding

Sowing of pre-germinated seeds on to puddled fields rather than the traditional transplanting of young plants, 25-30 days old, uses about 20-25% less water than in traditional transplanted rice. But weed control has to be ensured. When properly managed, grain yields of crops established by the wet seeding method will not be lower than what farmers get under the transplanted crop establishment.

Maintenance of water level during water scarcity

Intermittent irrigation instead of the traditional continuous submergence will help to save water to a considerable extent. Water is applied to the field and then stopped or suspended for a period until the soil is about to become dry at which time irrigation is resumed. Maintaining saturated condition could save upto 40% of water in clay loam soils without yield reduction, however weed control should be ensured through chemical, mechanical and manual means. Failure to maintain saturated condition (drying) could increase soil cracking which could increase percolation through soil cracks. During the 1990s, IRRI and national researchers successfully tested several water saving technologies such as saturated soil culture, saturated soil and soil drying, and alternate wetting and drying in farmer's fields. These methods have been reported to increase water productivity by reducing water input by upto 35% compared with continuous flooding, but grain yield decreased (Borell et al 1997; Lu et al 2000; Boumen and Tuong 2001, Tabbal et al 2002). For summer riceunder limited water availability, phasic stress irrigation can be practiced to the advantage of saving substantial quantity of irrigation water without any significant reduction in yield. About 20-30% more area can be irrigated with the same water resource by adopting phasic stress irrigation schedule. Depending upon the schedule, water saving ranges from 24-36% of the requirement of 5cm continuous submergence throughout the crop growth. Grain yield reduction in the above practice is only 0.1 -1.6%. Intermittent flooding maintaining the soil in sub-saturated condition and alternate drying and wetting can reduce water applied to the field by more than 49% compared with continuous submergence methods without affecting yields.

References

Borell A, Garside A and Fukai S (1997) *Improving Efficiency of Water Use for Irrigated Rice in A Semi Arid Tropical Environment.* **Field Crops Research** 52:231-248.

Bouman B A M andTuong T P (2001) *Field water management to save water and increase its productivity in irrigated low land rice.* **Agricultural Water Management** 49 : 11-30

Lu J, Ookawa T and Hirasawa T (2000) *The effects of irrigation regimes on the water use, dry matter production and physiological responses of paddy rice.* **Plant and Soil** 223 : 207-216

Tabbal D F, Bhuiyan S I, Sibayan E B and Sattar M A (2002) *On farm strategies in reducing water input in irrigated rice: Case studies in the Philippines.* **Agricultural Water Management** 56 : 93-112.

Schemes for Sustainable Rice Production

The Department of Agriculture, Government of Kerala has accorded sanction for the scheme on Comprehensive Development of Rice for implementation under the H/A 2401-00-102-90 plan, comprising four rice development scheme components viz a) Sustainable development of rice, b) Assistance to paddy development agencies, c) promotion of Specialty Rice and d) Operational support to Padasekara Samithies for group farming. The schemes aim at enhancing production and productivity and to sustain the rice cultivation by increasing productivity to around 3.2 MT/Ha by the end of the current plan period.

The scheme component 'Sustainable Rice Development' is being implemented to achieve a rice based farming system approach based on group farming concepts and scientific package of cultivation suited to each agro climatic condition for enhancing production and productivity , and simultaneously to bring down cost of cultivation.

The scheme component 'Specialty Rice development' is to promote and encourage the cultivation of traditional specialty rice varieties in Kerala like Pokkali, Njavara, Basmati and scented rice varieties like Jeerakashala and Gandhakasala ethnic to Wayanad district.

Assistance to Paddy Development Agencies

Govt of Kerala has constituted eleven paddy development agencies for tackling the problems of rice cultivation in special problem areas. Financial assistance of Rs.150 lakhs will be provided to the agencies for development of the problem area based on approved location specific projects on actual needs . The funds will be provided to Paddy Development Agencies based on the action plan approved by the Executive Committee of the concerned agency. The expenditure will be met from the H/A 2401-00-102-90 plan.

Promotion of Specialty Rice

The component sanctioned under this scheme is to promote and encourage the cultivation of traditional specialty rice varieties of Kerala like Pokkali, Njavara, Jeerakasala And Gandhakasala. Basmati cultivation will also be promoted since it is highly profitable. In order to motivate farmers to undertake cultivation of special rice varieties, which have high relevance in GI registry, it has been decided to give a higher incentive of Rs.l0,000/ Ha. Target proposed for cultivation of special rice verities is 1000 Ha during 2015-2016 with a financial outlay of Rs. 100 lakhs is as given below. The recommended varieties and areas are Pokkali 563Ha, Njavara 35Ha, Basmati 2Ha Jheerakasala and Gandhakasala 400 Ha.

Pokkali Rice

Among the Specialty Rice varieties of Kerala Pokkali rice is a traditional saline resistant rice variety which is cultivated in an organic manner in the coastal regions of Ernakulam, Alappuzha

and Thrissur districts of Kerala. Paddy cultivation is practiced in Pokkali tracts during the low saline phase starting from June to early November and prawn farming is practiced during the high saline phase of mid November to mid April. The organic Pokkali rice is famous for its special taste and high protein content. Since the tidal flows make the field highly fertile, no other manure or fertilizer needs to be applied to the crop, and hence naturally organic. In order to survive in the water logged fields, the rice plants usually grow up to a height of 2 meters. But as they mature, they bend over and collapse with only the panicles standing upright. Harvesting takes place in the month of October. Only the panicles are cut and the rest of stalks are left to decay in the water which is the feed for the prawns that start arriving in November - December. Cultivation of Pokkali rice will be promoted in an area of 563 Ha in the districts of Alappuzha , Ernakulam and Thrissur.

Njavara Rice

It is a unique indigenous rice cultivar of the state having medicinal properties. This rice variety has got immense potentialities in our indigenous system of medicines generally used in *Njavara kanji* and *Njavara Kizhi*. Cultivation of *Njavara* is generally centered on northern districts of the State. Cultivation of *Njavara* rice will be promoted in an area of 35 Ha in the districts Palakkad , Wyanad and Kannur.

Basmati Rice (Promotion of Basmati rice cultivation)

Basmati-370 and Taroari Basmati are the widely cultivated varieties of export quality. Combining the quality features of traditional varieties and yield potential of high yielding semi dwarf varieties suited to be cultivated in all parts of India. Basmati is grown during summer months to get best results for right aroma.. Promotion of Basmati rice will be done with the help of selected Padasekhara samithies, SHGs, Kudumbasree units and NGOs. Since Basmati rice fetches premium price the income of the farmer will be sustainable. Since cultivation of basmati is being done on a promotional basis the physical target will be limited to 2 Ha.

Jeerakashala and *Gandhakashala*

Farmers of Wayanad district follow a distinct traditional practice of raising ordinary red kernelled indica type for daily consumption and scented rice for the preparation of special dishes. In Wayanad district Panamaram, sulthan Bathery and Mananthavady are the main area where farmers including tribal people are cultivating scented rice varieties like *Jeerakashala* and *Gandhakasala*. These varieties are very popular due to its good taste and aroma Climate of this area is also suitable for growing scented rice varieties. However lack of financial support has resulted in the area under cultivation coming down over the years. During 2015-2016 *Jeerakashala* and *Gandhakashala* cultivation will be promoted in an area of 400 Ha in Wayanad district as a part of promoting indigenous high value paddy varieties.

Details of Assistance

The padasekara samithies have to be strengthened to encourage group activities by integrating state schemes under rice development, rice development programme of local self Governments & RKVY rice schemes. Consequent to the introduction of e-payment system of crediting subsidy to individual bank account of farmers, the availability of funds for group activities with padasekaara samithies are practically nil. In such situation, operational support of padasekhara samithies is an inevitable item for the existence and functioning of padasekhara samithies.

WANT MORE PRICE? COLOUR IT!!

Colouring seeds for brand value..

Seed sector is very dynamic and it always comes up with innovations to rule the industry. Seed colouring is the modern trend practiced by both private and public firms mainly to establish their brand-signature as well as for attractiveness. But it is very much prevalent in developed countries since a decade.

ANIL SEBASTIAN[1], SAEED T.[2] and RESHMIKA P.K.[3]

[1]Ph.D Scholar, TNAU, [2]Senior Research Fellow, Microbiology, [3]Ph.D. Scholar, KAU.
Email: sebastiananil.151@gmail.com

Commercial formulation

Colouring pigment added to seed

Value added seed

Colouring of seeds along with pelleting, film coating, coating with biologicals is adopted in private sector seed companies in United States, Canada and Europe. Several different types of dyes have been used successfully for colouring seeds, including acid dyes, basic dyes, direct dyes and pigments. Natural dyes have several advantages on health, safety and ecological point of view. In addition, most of them have medicinal and anti-microbial properties. Earlier, natural dyes were used for cosmetics and

Colours Produced by Natural Dyes

The colours produced by the different plant dyes can be identified using the munsen colour chart, the active principle for colouring and pH of the dye solutions are furnished below:

Botanical dyes	Colour appearance	Active principle
Henna	Sand stone	Not known
Beetroot	Teak	Betanin
Hibiscus	Sand stone	Syanidin diglycoside
Basella	Leaf brown	Not known
Anatto	Dawn glow	Bixin
Jamun (without seed)	Brandy	Jamboline
Jamun (with seed)	Sand stone	Jamboline
Marigold	Golden brown	α-terthienyl
Turmeric	Lemon yellow	Curcumin

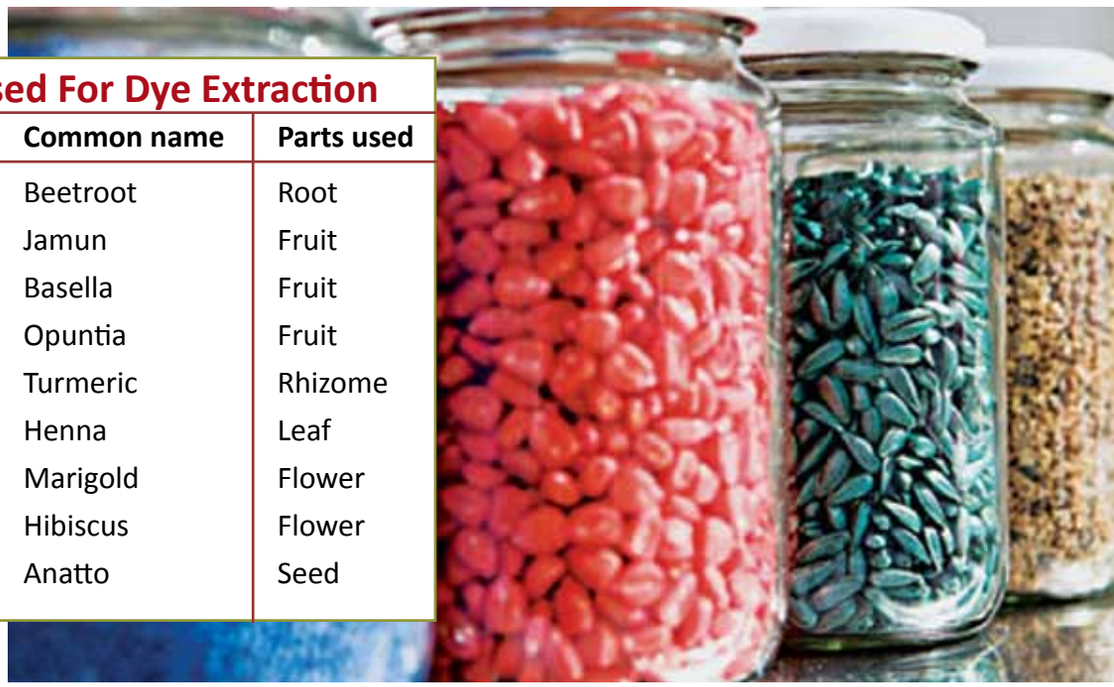
colouring fabrics. Few elite seed companies in India came forward for seed colouring with imported technologies. They import both the colouring materials and sophisticated machinery at a huge cost. In other cases, the colouring materials and processes adopted are very primitive without any scientific ground. A wide reformation gap exists in our country in this promising area of recent interest.

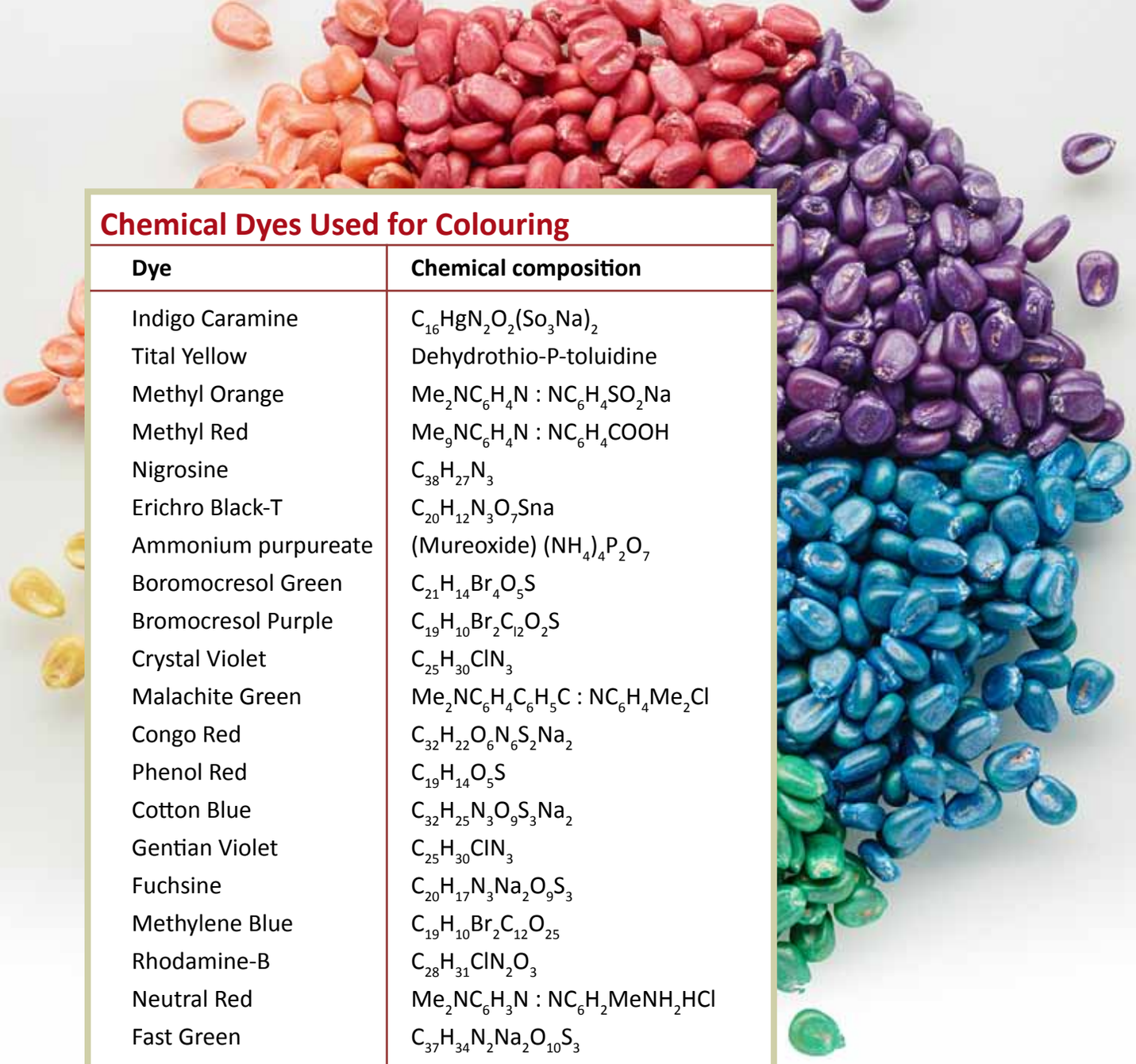
What is Seed Colouring ?

Seed-colouring is colouring of seeds with different naturally colouring dyes and artificial chemical dyes in order to enable brand identification and to give the seed a distinct and attractive look. Seed-colouring is also an enhancement technique mainly done to improve its marketability, brand identity and to enable the farmers for easy identification of the varieties based on colour. It also acts as insect and bird repellant. Among seed in storage, lots of different years could be easily identified and adulteration of seeds can be checked. It is feasible in vegetables as they are high value low volume crops.

Plants and its Parts Used For Dye Extraction

Botanical name	Common name	Parts used
1. *Beta vulgaris*	Beetroot	Root
2. *Syzygium cuminii*	Jamun	Fruit
3. *Basella rubra*	Basella	Fruit
4. *Opuntia spp*	Opuntia	Fruit
5. *Curcuma longa*	Turmeric	Rhizome
6. *Lawsonia inermis*	Henna	Leaf
7. *Tagetes erecta*	Marigold	Flower
8. *Hibiscus rosa-sinensis*	Hibiscus	Flower
9. *Bixa orellana*	Anatto	Seed





Chemical Dyes Used for Colouring

Dye	Chemical composition
Indigo Caramine	$C_{16}HgN_2O_2(So_3Na)_2$
Tital Yellow	Dehydrothio-P-toluidine
Methyl Orange	$Me_2NC_6H_4N : NC_6H_4SO_2Na$
Methyl Red	$Me_9NC_6H_4N : NC_6H_4COOH$
Nigrosine	$C_{38}H_{27}N_3$
Erichro Black-T	$C_{20}H_{12}N_3O_7Sna$
Ammonium purpureate	(Mureoxide) $(NH_4)_4P_2O_7$
Boromocresol Green	$C_{21}H_{14}Br_4O_5S$
Bromocresol Purple	$C_{19}H_{10}Br_2C_{l2}O_2S$
Crystal Violet	$C_{25}H_{30}ClN_3$
Malachite Green	$Me_2NC_6H_4C_6H_5C : NC_6H_4Me_2Cl$
Congo Red	$C_{32}H_{22}O_6N_6S_2Na_2$
Phenol Red	$C_{19}H_{14}O_5S$
Cotton Blue	$C_{32}H_{25}N_3O_9S_3Na_2$
Gentian Violet	$C_{25}H_{30}ClN_3$
Fuchsine	$C_{20}H_{17}N_3Na_2O_9S_3$
Methylene Blue	$C_{19}H_{10}Br_2C_{12}O_{25}$
Rhodamine-B	$C_{28}H_{31}ClN_2O_3$
Neutral Red	$Me_2NC_6H_3N : NC_6H_2MeNH_2HCl$
Fast Green	$C_{37}H_{34}N_2Na_2O_{10}S_3$

Advantages

1. Prevents inadvertent mixing of high value seeds with other seeds of same crop.
2. Gives protection to seed.
3. Seal the cracks on seed coat.
4. Improves the physical appearance.
5. Provides a smooth and even surface enhancing market value and plant ability.
6. Gives a distinct and attractive look to the seed.

Disadvantages

1. Involves extra cost.
2. Time consuming.

Seed-colouring can be easily done in vegetables and it is economical as well since it is low volume high value crop. Apart from imparting attractiveness, seed-colouring helps in brand identity, prevent birds and animals etc. Identification of proper natural dyes and low cost colouring material is important for economical seed-colouring.

FOOD
FUNCTIONAL

GO GREEN..
go for MICROGREEN..
for better health and living..





Micro-greens represent a new class of vegetables that can be considered as *'functional foods'*. They are defined as salad crop shoots harvested for consumption within 10-20 days of seedling emergence. Over the past few years, microgreens have gained popularity as a new culinary trend.

MANISH KUMAR*,
PRASHANT K. NIMBOLKAR AND
RAJEEV KUMAR YADAV

Ph.D (Horticulture)
ICAR-IARI, New Delhi
***Email: imanishkumar91@gmail.com**

In recent years, people have a substantial interest for the consumption of fruits and vegetables which are characterized by a high content of bioactive substances. It is known that, these are beneficial not only because they provides the necessary nutrients for human body but also have important effects on health. Over the past few years, microgreens have gained popularity as a new culinary trend. Microgreens also possess particular health promoting or disease preventing properties that are additional to their normal nutritional values. Microgreens are defined as salad crop shoots harvested for consumption within 10-20 days of seedling emergence. They are larger than sprouts, but are smaller than 'baby' greens. Micro-greens have a central stem with two fully developed cotyledon leaves and mostly one pair of small true leaves. They are very specific type of vegetables which include seedlings of edible vegetables, herbs or other plants, ranging in size from five to ten centimeters long (including stem and cotyledons). Nowadays, demand for these products is growing rapidly and consumption is increasing due to their particular characteristics like, unique colour, rich flavor and appreciable content of bioactive substances. These are also classified as a good source of minerals in human diet.

Forms and Uses

Microgreens have three basic parts: a central stem, cotyledon leaf or leaves, and typically the first pair of very young true leaves. They

Brassica rapa

Swiss chord: A microgreen vegetable

A healthy microgreens ready to eat

Sprouted microgreens

Detroit dark red

vary in size depending upon the specific variety grown, with the typical size being 1 to 1.5 inches (25 to 38 mm) in total length. When the green grows beyond this size, it should no longer to be considered as microgreens. Larger sizes have been called *petite greens*. Microgreens are typically 2–4 weeks old from germination to harvest. Both baby greens and microgreens lack any legal definition. The terms "baby greens" and "microgreens" are marketing terms used to describe their respective categories. Sprouts are germinated seeds and are typically consumed as an entire plant (root, seed, and shoot), depending on the species. Microgreens can be eaten in several simple ways. Be sure to rinse them thoroughly first then, eat them raw or garnish meals with raw microgreens. They are also very tasty on their own.

Nutritional Value

Researchers at the USDA Agricultural Research Service have published, as of early 2014, several studies that identify the nutritional make-up and the shelf life of microgreens. Microgreens are rich source of ascorbic acid (vitamin C), tocopherols (vitamin E), phylloquinone (vitamin K) and beta-carotene (vitamin A precursor) and other related carotenoids in the cotyledons.

Among the different microgreens, red cabbage, cilantro, garnet amaranth and green daikon radish have the highest concentrations of vitamin C, carotenoids, vitamin K and vitamin E respectively. In general, microgreens contain considerably higher levels of vitamins and carotenoids about five times greater than their mature plant counterparts, an indication that microgreens may be worth the trouble of delivering them fresh during their short lives.

What can be grown as microgreens?

Commonly grown microgreens include amaranth, basil, beet, cabbage, celery, chervil, chinese kale, cilantro, fennel, garden cress, mustard, parsley, radish, rocket or arugula, snow pea, Swiss chard *etc*.

Production technology of microgreens

Any grain or seed can be used to produce microgreens. Different grains used for producing microgreens include monocotyledons like wheat, rice, maize, millet, sorghum *etc*. and dicotyledons like beans, peas, pulses, sunflower, mustard, cabbage, cauliflower, carrot, radish, beet root *etc*. They require high light levels, preferably natural sunlight with low humidity and good air circulation. Such conditions ideal for microgreens do not encourage the growth of dangerous pathogens.

Microgreens are grown in small mud or plastic pots or shallow trays with drainage holes. The growing medium consists of soil, pot mixture (soil, compost or animal manure, coir pith, tank silt and fertilizer micronutrients) or peat moss. They are planted at very low seed density. Seeds are soaked in water for 12 hours and then drained

and pre-germinated for in a moist cloth for 24 to 36 hours. Pre-germinated seeds are sown thinly on soil surface in pots or trays and covered with a thin layer of soil. The soil is kept moist or wet by spraying water 2-3 times a day. Microgreens are allowed to grow for 7 to 14 days in tropical climate and slightly longer (14 to 28 days) in cold weather or temperate regions. They are ready for harvest when the two true leaves are fully expanded. If left for longer, they will begin to rapidly elongate and lose colour, flavour and probably nutritional value. When ready, the tender young plants are cut just above the soil surface (and leaving the roots in the soil), washed in clean water to remove any soil particles and collected into small bundles for consumption or marketing. Harvested microgreens are highly perishable and should be washed and cooled as quickly as possible. Microgreens are usually packed in small plastic clamshell packages and cooled to recommended temperatures. Precautions must be taken to avoid any microbial contamination during and after harvesting the microgreens.

Shelf life of microgreens

Generally, microgreens have limited shelf-life (approximately one week) and so, they can't ship well. They must be consumed immediately after harvest. Increasing the shelf life of microgreens is a big challenge for scientist. Researchers are trying to optimize packages that provide the optimal atmospheric composition required to extend the shelf-life of microgreens. Commercial microgreens are most often stored in plastic clamshell containers,

Microgreens bring garden to your kitchen

Microgreens salad

A composed view of microgreens

which do not provide the right balance of oxygen and carbon dioxide for live greens to breathe.

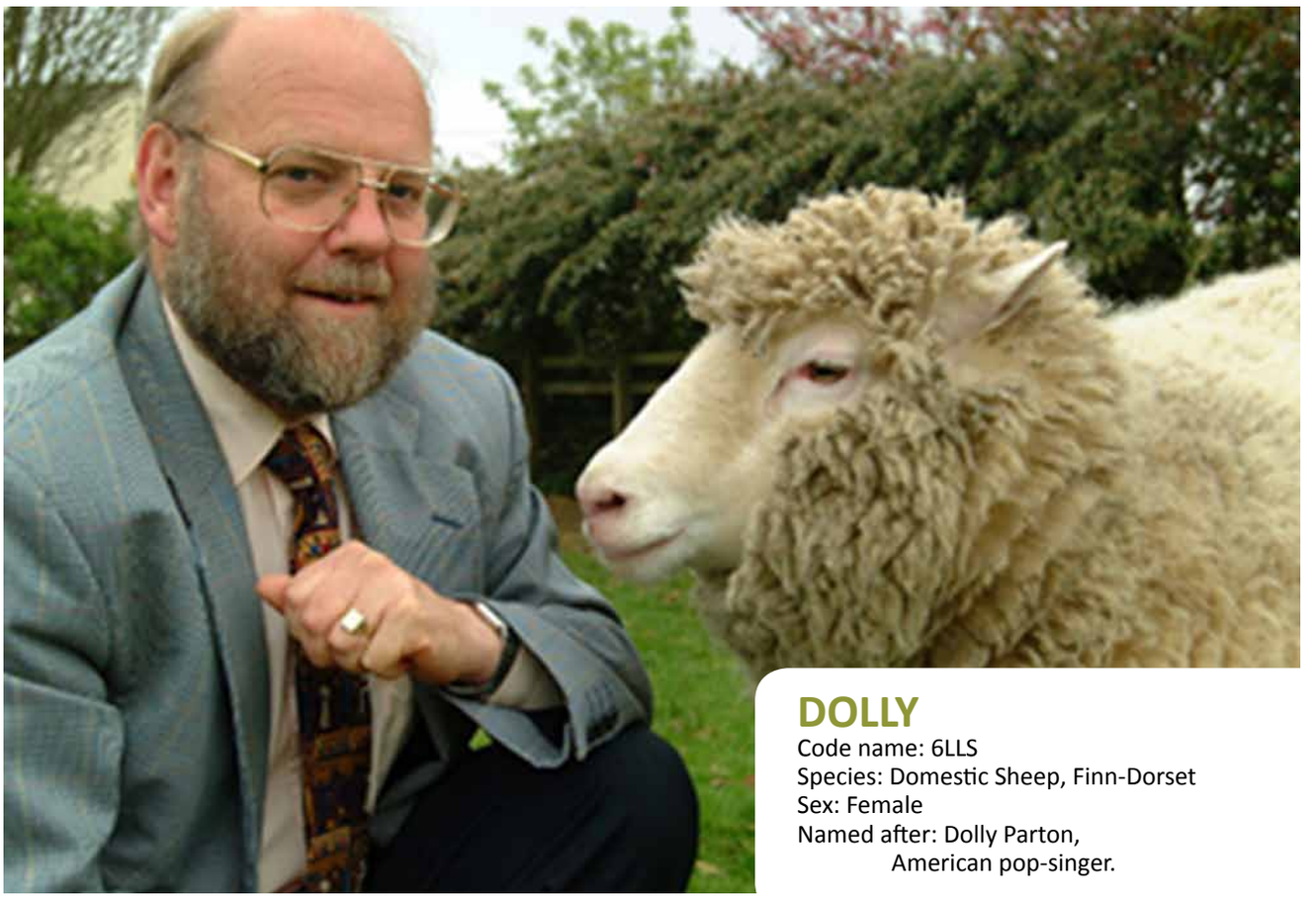
Major considerations in microgreens

For microgreens production, it should be noted that due to the high price and high perishability, microgreens are not currently available to commercial terms in chain stores. This crop has a quick production cycle (two to three weeks) and occupies very little space in greenhouse production. However, shortening the production cycle and thus reducing green house production cost is one of the major goal of the current researches. Another issue addressed was that the impact of the biotic stress on sprouts and microgreens, results in the necessity of obtaining disease free products. The need to extend their shelf life is also a recent concern to researchers. Pre-harvest or post-harvest treatments can be effective means to achieve this objective.

Microgreens are gaining importance in today's world due to its aesthetic and nutritional value. It has spread a faraway in many developed countries like USA, China etc., but it is still infancy in our country and mainly occupied its place in big hotels near the cities. Main problem associated with it, is a lack of awareness among people and scientists about its cultivation and its applicability in our society. Other main problem associated with its cultivation is its high price, high perishable nature and problems related to its marketability.

Dish prepared from microgreens

Hello Dolly!



DOLLY
Code name: 6LLS
Species: Domestic Sheep, Finn-Dorset
Sex: Female
Named after: Dolly Parton,
American pop-singer.

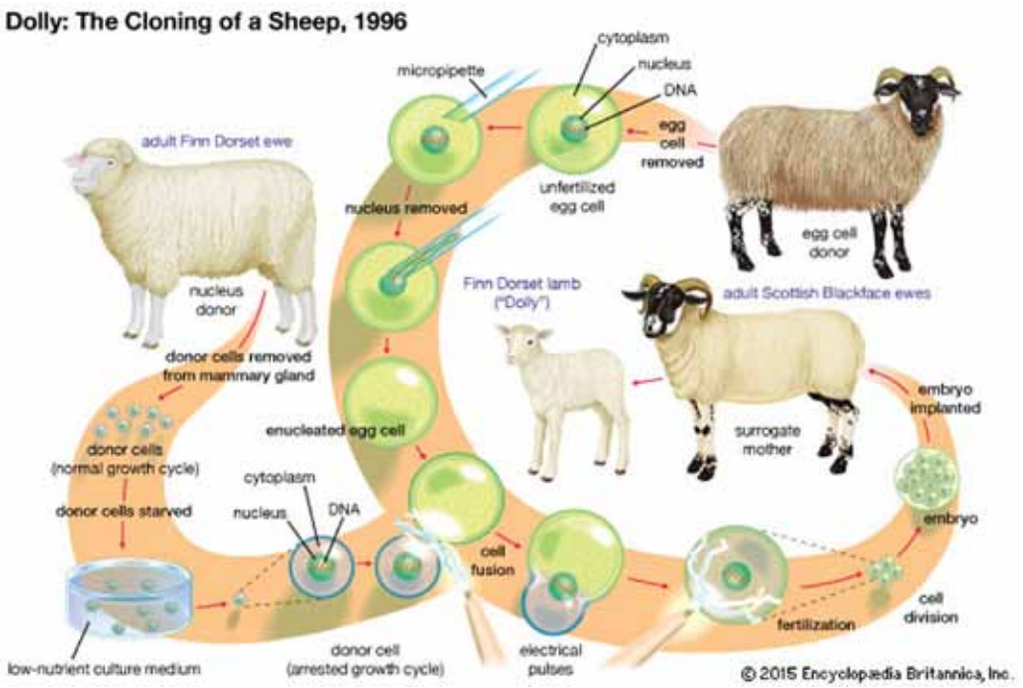
N.S. Arun Kumar

2016 marks the 20th anniversary of the birth of Dolly the Sheep, the first mammal to be cloned from an adult cell. Dolly made a huge impact on both the scientific community and the general public and sparked an intense global debate about cloning and its ethical implications. An icon of British innovation, she is arguably one of the best known figures in science to this day. After cloning was successfully demonstrated through the production of Dolly, many other large mammals were cloned, including pigs, deer, horses and bulls. But the situation was different in 1990s. In 1996, Dolly was the only lamb that survived to adulthood from 277 attempts. However by 2014, Chinese scientists were reported to have 70–80% success rates cloning pigs and in 2016, a Korean company, *Sooam Biotech* was producing 500 cloned embryos a day. Wilmut, who led the team that created Dolly, announced in 2007 that the nuclear transfer technique may never be sufficiently efficient for use in humans.

Hello Dolly

Dolly started her life, as with all other cloned animals, in a test tube. Once normal development was confirmed at 6 days, the embryo, that was eventually to become Dolly, was transferred into a surrogate mother. Pregnancy was confirmed by an ultrasound scan at about 45 days of gestation and the pregnancy was monitored closely for the remaining 100 days. The pregnancy went without a problem and Dolly was born on the 5th July 1996. Unlike many cloned animals, who often have neonatal problems at birth, Dolly was a normal vigorous lamb and was standing and sucking unaided within minutes. The animal technicians were aware that this was an important lamb and critical to the research team that had produced her but they were completely unaware of the impact

she would finally have. The birth of Dolly was kept under wraps until the publication of the results could be prepared. Once these results were released, the full impact of the discovery became plain to all the animal carers, as the world's press descended on Roslin. Most staff thought that this initial interest would be brief and quickly fade, but that was not the case and the press, in all shapes and forms, regularly visited Dolly for one reason or other for the rest of her life with interest peaking every time there was any concern over her health.



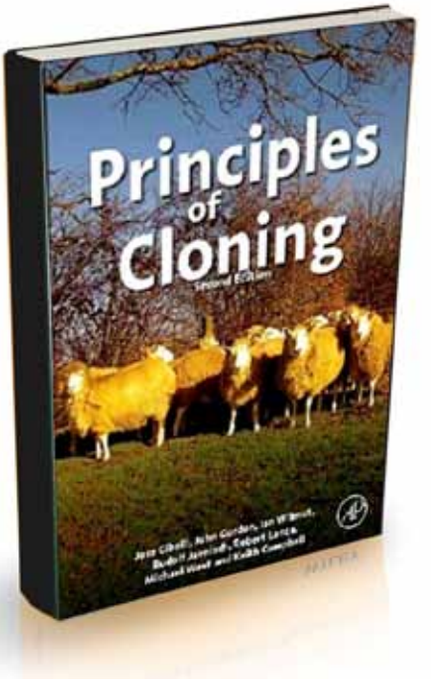
Dolly's Family

To produce Dolly, scientists used an udder cell from a six-year-old Finn Dorset white sheep. They had to find a way to 'reprogram' the udder cells - to keep them alive but stop them growing – which they achieved by altering the growth medium (the 'soup' in which the cells were kept alive). Then they injected the cell into an unfertilised egg cell which had had its nucleus removed, and made the cells fuse by using electrical pulses. The unfertilised egg cell came from a Scottish Blackface ewe. When the research team had managed to fuse the nucleus from the adult white sheep cell with the egg cell from the black-faced sheep, they needed to make sure that the resulting cell would develop into an embryo. They cultured it for six or seven days to see if it divided and developed normally, before implanting it into a surrogate mother, another Scottish Blackface ewe. Dolly had a white face.

From 277 cell fusions, 29 early embryos developed and were implanted into 13 surrogate mothers. But only one pregnancy went to full term, and the 6.6 kg Finn Dorset lamb *6LLS* (alias Dolly) was born after 148 days. In an attempt to allow Dolly to have as normal as life as possible it was decided that she should be allowed to breed. A small welsh mountain ram was selected as her mate and between them they successfully produced 6 lambs. Their first, Bonny, was born in the spring of 1998. Twins followed the next year and triplets the year after that.

Dolly's final illness

Dolly lived a pampered existence at the Roslin Institute. She mated and produced normal offspring in the normal way, showing that such cloned animals can reproduce. Born on 5 July 1996, she was euthanased on 14 February 2003, aged six and a half. Sheep can live to age 11 or 12, but Dolly suffered from arthritis in a hind leg joint and from sheep pulmonary adenomatosis, a virus-induced lung tumour that is common among sheep which are raised indoors. On 14 February 2003, Dolly was euthanised. A Finn Dorset such as Dolly has a life expectancy of around 11 to 12 years, but Dolly lived 6.5 years. The DNA in the nucleus is wrapped up into chromosomes, which shorten each time the cell replicates. This meant that Dolly's chromosomes were a little shorter than those of other sheep her age and her early ageing may reflect that she was raised from the nucleus of a 6-year old sheep. Dolly was also not entirely identical to her genetic mother because the mitochondria, the power plants of the cell that are kept outside the nucleus, were inherited from Dolly's egg donor mother. A post-mortem examination showed she had a form of lung cancer called Jaagsiekte, which is a fairly common disease of sheep and is caused by the retrovirus JSRV. Since Dolly, other sheep have been cloned from adult cells, as have cats, rabbits, horses and donkeys, pigs, goats and cattle. In 2004 a mouse was cloned using a nucleus from an olfactory neuron, showing that the donor nucleus can come from a tissue of the body that does not normally divide. Improvements in the technique have meant that the cloning of animals is becoming cheaper and more reliable.



Title : *Principles of Cloning*

Editors : Cibelli & Wilmut & Jaenisch & Gurdon & Lanza & West & Campbell

Publisher : Academic Press

ISBN : 9780123865427

Principles of Cloning, Second Edition is the fully revised edition of the authoritative book on the science of cloning. The book presents the basic biological mechanisms of how cloning works and progresses to discuss current and potential applications in basic biology, agriculture, biotechnology, and medicine. Beginning with the history and theory behind cloning, the book goes on to examine methods of micromanipulation, nuclear transfer, genetic modification, and pregnancy and neonatal care of cloned animals. The cloning of various species—including mice, sheep, cattle, and non-mammals—is considered as well.

The Editors have been involved in a number of breakthroughs using cloning technique, including the first demonstration that cloning works in differentiated cells done by the Recipient of the 2012 Nobel Prize for Physiology or Medicine – Dr John Gurdon; the cloning of the first mammal from a somatic cell – Dr. Keith Campbell and Dr. Ian Wilmut; the demonstration that cloning can reset the biological clock - Dr. Michael West and Dr. Robert Lanza; the demonstration that a terminally differentiated cell can give rise to a whole new individual – Dr. Rudolf Jaenisch and the cloning of the first transgenic bovine from a differentiated cell – Dr Jose Cibelli. The majority of the contributing authors are the principal investigators on each of the animal species cloned to date and are expertly qualified to present the state-of-the-art information in their respective areas.

Selected Chapters

Intercrop Your Coconut Groves With *Heliconia*

Growing of *Heliconia* for a period of three years increases the yield of coconut. The higher yield in coconut was mainly because of increased fruit-setting which might be attributed to enhanced soil moisture retention with better nutrient balance on coconut rhizosphere.

K. NIHAD, V. KRISHNAKUMAR AND A. ABDUL HARIS

Central Plantation Crops Research Institute, Regional Station, Kayamkulam.
Email: nihadshukoor@gmail.com

Coconut is the major plantation crop in coastal humid tropics which is perennial in nature. In the yielding phase, it utilizes only 25% of the land area and offers greater scope for intercropping. Landscaping the coconut plantation with traditional and underutilized flower crops is a new trend towards eco-tourism promotion. Intercropping with compatible flower crops in coconut gardens not only enhances the farm income but also ensures aesthetic values promoting ecotourism. The global cut flower export has risen from Rs.4 million to Rs.180 million during the past decade. *Heliconias* are tropical cut flowers which come up well in organic rich soils. Their inflorescence is preferred for its diversity in form, colour, size and particularly, its vase life.

Heliconia flowers are highly modified leaves called bracts, which may be erect, pendulous or spiraling in the shapes of bird's beak, lobster claws or fan-shaped and with colors of reds, pinks, gold, oranges and splashes of a mixture of colours. The demand for ornamental *Heliconias* has increased, both in national and international markets, and its cultivation has been reported as a

Why *Heliconia*..?

1. Short flowering cycle
2. Light flowering stems for lower transportation costs
3. Stems longer than 80 cm
4. Stems with diameter thick enough for better resistance to handling and for lighter total weight of inflorescence
5. Inflorescences with no wax and no hair; and bracts arranged in one plane for easier handling and packing
6. Inflorescence width and length of more than one meter
7. Firmness of bract
8. Bract with few or no flowers inside
9. Post harvest durability or vase life of more than seven days

major factor in the agricultural economy of many countries.

Heliconias are well adapted to all major agro climatic zones of our country. The genus is made up of about 100 species along with a large number of hybrids and cultivars. The requirement of light for growth and flowering varies with species to species. Unlike other suitable cut flowers such as anthuriums and orchids for intercropping, *Heliconias* comes up well in the natural microhabitat of coconut canopy.

Heliconia stricta 'Iris' is a commercial variety with all the above preferred characteristics. The inflorescence characters come in the range with fresh weight of stems (101 -200 g), stem diameter (10.1-30.0mm), stem length (50.1-150.0cm) and spike length (10.1-30.0cm). A single inflorescence of *Heliconia stricta* 'Iris' can fetch Rs. 20 to Rs.250 in the national market. Large flowers of more than one meter length can fetch $2 to $18 each in International markets.

Planting material

Seven months old rhizomes with collar girth of more than 9 cm can be used as planting material. After removing the leaves, rhizomes cut back at one meter height from the basal end is used as planting material.

Planting

Heliconia rhizomes are planted in pits of size 30cm x 30cm x 30cm. Planting can be done except during winter and heavy monsoon seasons. However, the ideal time for planting is from August to November. For commercial cultivation at least 250 plants are to be planted which requires 25cents of coconut plantation. The rhizomes are planted at 1.5 m spacing leaving an area of 2m around the coconut basins. The pits are refilled with top soil mixed with dried cow dung (1kg/pit) and bone meal (250g/pit).Mulching with dried leaves or coir pith is done after planting. Rhizomes start sprouting at forty five days after planting. Thinning of eight month old suckers with less than 7cm diameter should be carried out monthly for promoting production of more number of quality inflorescence.

Irrigation

Heliconia plants always require moist soil. It needs to be irrigated once in two days during summer. The frequency of irrigation can be reduced to once in four days by providing mulching with coir-pith compost during February-March.

Manuring

In sandy loams, *Heliconia* 'Iris' can be grown either purely organic or in an integrated way using organic manures and chemical fertilizers. The manures and fertilizers are applied at quarterly intervals beginning from three months after planting. For organically grown *Heliconias*, 200g vermi-compost (dried coconut leaves can be converted to vermi-compost using earthworms of Eudrillus sp.) and 100g neem-cake per plant are applied at three months interval. For integrated method of cultivation, half the dose of vermi-compost and neemcake (100g and 50 g per plant)

along with 13:5:13 NPK (5g per plant) can be given at three months interval. In both the conditions, drenching diluted cow dung slurry in the ratio 1:10 at six monthly interval enhances the production of quality inflorescence.

Plant protection

No major pest is recorded from *Heliconia* 'Iris'. However, rotting of leaves is common during heavy monsoons. Spraying with *Mancozeb* 75%WP @ 2.5g/l was found to be effective in controlling leaf rot.

Yellowing

Yellowing of leaf during the early growth stages is noticed in *Heliconia stricta*. This is mainly due to nutrient deficiency, particularly Potassium. If yellowing persists, one time application of 60g MOP per plant is recommended at vegetative phase.

Harvesting

Heliconia 'Iris' starts flowering at eight months after planting. Harvesting is usually done before 9am in the morning or after 4pm in the evening by cutting the rhizome along with the inflorescence at ground level. After cutting, the outer leaves are stripped off and the top most leaf blades are cut leaving the petiole. They are used in stage decorations, bouquet making, long arrangements etc. The vase life of inflorescences is 10-12 days.

Inflorescences of around one meter length and 9 cm stem girth with two or more open bracts are selected for sale. Smaller inflorescences can be used for value addition such as bouquets and table top arrangements. In order to remove the field heat,

the cut end of the inflorescence stem is dipped in tap water for about an hour. These are then washed in water for removing soil and dust. The excess water is wiped off and inflorescences are graded based on their length. Inflorescence with fewer flowers inside the bracts are ideal for marketing as it will reduce time and cost of cleaning and minimize occurrence of insects, odours from water accumulation and organic matter deterioration. At least 4 to 5 marketable inflorescences are produced in the first year of planting itself. It produces 45-50 inflorescences/ clump/year in the subsequent years. *Heliconia* stricta needs to be replanted after 3-4 years.

Grading

Inflorescence of Heliconia Iris can be graded based on their length, stem girth and spike width.

Grades	Length of inflorescence (cm)	Stem girth (cm)	Spike width (cm)
Grade I	>100	>9	>25
Grade II	75-100	7-9	20-25
Grade III	<75	<7	<20

Packing

Inflorescence can either be packed individually or in bulk. A minimum of 45 numbers of inflorescence is needed for bulk packing. In bulk packing, uniform sized inflorescences are packed in a single box. Different materials such as Aluminum foil, butter paper and news papers or recycled papers can be used for wrapping the inflorescence. In individual packing boxes of 100cm x 10cm x 45cm size are used. A total of three boxes are packed inside a paper box of size 120cm x 45 cm x 45cm. These boxes are provided with air vents on opposite sides. Bulk packing is the usual method adopted by *Heliconia* farmers. The packing cost can

Indirect marketing

There are various value chains in indirect marketing. The major ones existing in India are listed below:

The price of individual inflorescence and minimum number of inflorescences required during each step of transaction is given in brackets.

a. **Farmer** (Rs. 35-40/-,20-30 nos) → Florist (100-150 nos)

- @Rs.100-150/- As cut flower (10-20nos), Bouquet making (10-30 nos), Stage decoration (80-100 nos) @ Rs.15-20
- @ Rs.75-100/-
- @ Rs.50-60/-

b. **Farmer** (> 50 nos.) @Rs.30-35/- @Rs.50-60/- → Collection agent (200 nos)(After grading, packing)

Collection agent (200 nos)(After grading, packing) → Wholesalers (600 nos)

Wholesalers (600 nos) →

- @Rs. 80-100/- → Retailers (200nos) → Stage decorators/florists (150 nos)
- @ Rs.150-200/- → Hotels (50 nos.)

c. **Farmer** (50-100 nos) (After grading and packing) @Rs.60-80/- → Wholesalers (200 nos.)

- @Rs.30-35/- → Retailers (300 nos)
- Wholesalers (200 nos.) →

Retailers (300 nos) @Rs.100-150/- → Stage decorators/florists/Hotels (10-20 nos)

be substantially reduced if recycled paper is used for wrapping the inflorescence. The inflorescence will keep its quality for 24 h under this method.

Packing of inflorescences using recycled paper can be done in two ways:

Bulk method: First two layers of recycled papers are spread at the bottom of the box. Six inflorescences are arranged in a layer such that three will be faced in opposite direction. The bracts of each layer of inflorescence are protected from vibration injury by covering with a sheet of recycled paper. A total of seven layers of inflorescences can be packed inside a box of 120cm x 45cm x 45cm size holding 42 inflorescences per box.

Individual method: In this method individual inflorescence are wrapped separately with recycled paper. The bracts of individual inflorescence is

Year	Input cost (Rs.)	Returns (Rs.) Inflorescence @ Rs20/-	Net returns (Rs.) Rhizomes @Rs.60/-	Benefit cost ratio
I yr	5,87,000	96000	-	-4,91,000
II yr	10,20,000	21,60,000	9,00,000	30,60,000 3:1
III yr	16,00,000	27,00,000	21,60,000	48,00,000 3:1

covered and packed in layers of three in opposite direction. In this method 5-6 layers of inflorescence can be packed inside a box of size 120cm x 45cm x 45cm holding 30-36 inflorescences per box.

Marketing channels

Heliconia inflorescences can be marketed either directly to consumers or through middle men. The major value chains of *Heliconia* in our country are listed below:

Direct marketing

By adopting direct marketing farmer will get maximum benefit. It can either be sent directly to star hotels in major cities of India or can be used for value additions such as flower arrangements or bouquets. Bouquet making and flower arrangements are profitable value additions which can be adopted by women self help groups located in major cities.

a. Farmer (Rs. 200-250/- per inflorescence) ⟶ Hotels in metropolis

b. Farmer ⟶ Bouquets / flower arrangements (Rs. 100-150/- per inflorescence)

Economics of cultivation

The economics of intercropping Heliconia stricta 'Iris' for three years in one hactre of coconut plantations is given below:

The initial cost of cultivation is very high due to the cost of planting material which may require financial support from banks etc. The cultivation of Heliconias open up scope for employment generation and youth empowerment through export, value addition such as bouquet making, flower arrangement, stage decoration etc. Additional labour employment of 1000 man days/ha in the first year, 1800-2000 man days/ha in second year and 2500 man days/ha in third year is expected.

Heliconias are emerging as an important cut flower in India which can be grown as intercrops in coconut gardens. At present marketing is concentrated in domestic markets of metros which itself is fetching high profit. The scope of exporting needs to be explored. The major constraint of exporting is the weight of inflorescence. A single inflorescence of many commercial varieties weighs even up to 750g. *Heliconia stricta Iris* is a potential variety for exporting as it has the qualities of grade I flowers such as more than one meter inflorescence length, inflorescence girth, plane arrangement of bracts, unique colour, lesser number of flowers inside the bract coupled with lesser inflorescence weight of up to 250g. The export market for Heliconias can be boosted by giving brand names and exporting to developed countries such as USA, Australia, UK where the demand for these tropical ornamentals is very high.

Hill banana is a popular cultivar in the hills of Tamil Nadu, especially in the lower Pulney's, growing at a height of 3000-4500 feet from the mean sea level. Hill banana cultivation is very unique and specially confined to the state of Tamilnadu in India.

'Virupakshi' and *'Sirumalai'*

The Hill Bananas of Tamil Nadu

NITHIN KUMAR C J

Horticulture College & Research Institute,
Periyakulam. Tamil Nadu Agricultural University
Email: nithincjkumarhort@gmail.com

Hill banana is a perennial type that can be maintained in the field for 10-15 years depends on management of the crop. It is successfully cultivated in sub-tropical regions of Tamilnadu viz., Lower palney hills, Sirumalai hills, Agamalai, Megamalai, Vellimalai, Pachamalai, Kalvarayan hills and Yelagiri hills is an area of 7000 hectares. Under this nearly 95 percent of the area comes under rainfed crop.

Hill Banana

There are two main types in hill banana viz., '*Virupakshi*' and its ecotype 'Sirumalai'. The fruits of '*Sirumalai*' are tastier, with more mellowy pulp and finer flavour than those of '*Virupakshi*' Which are slightly sub-acid. For the *Panchamirtham* of the well known Palani temples, only '*Virupakshi*' fruits are used. The hill banana of lower palanis are now being tried at higher elevations of many states of India to replace the inferior type. When grown on the plains, both ecotypes deteriorate in quality. It can also be given to babies since it has a high content of vitamin C and medicinal property.

Virupakshi (AAB)

Synonyms: *Malai Vazhai* and *Vella Vazhai*

This type is very distinct and extensively cultivated on the lower Palani hills in Dindigul and Theni district of Tamilnadu state. This is a delicious table variety with a good flavour, being a semi solid fruit, this has a very good keeping quality and has captured the fruit market with a grand trade with a premium price in the state. This is a poor yielder. Bunches are small having about 5-7 hands each

VIRUPAKSHI- THE FAVOURITE OF LORD MURUGA

Virupakshi is the main ingredient in the preparation of *Panchamirtham* of Palani temple, the famous temple in South India. The *Panchamirtham* can be kept for more than three months after opening the container and without opening upto one year can store. No other banana variety is preferred for the preparation of '*Panchamirtham*'. This product is exported to *Malasia*, Singapore and Srilanka.

with 11 or 12 fruits and weighing 8-12 kg. Fruits medium to small, about 13.0 to 15 cm long and 10-12 cm girth, spindle shaped, almost straight, plump in the middle, somewhat five sided and angle ridges prominent, sides slightly inflated, base broad, tapering to a short pedicel, apex blunt with short and thick beak, skin thick, leathery to touch, with considerable amount of white spongy fiber on the inner surface, lemon yellow coloured, peeling off easily from the pulp. Pulp firm, white or very pale yellow in colour, core inconspicuous, taste sweet with a delightful flavour, dry and has a very good keeping quality.

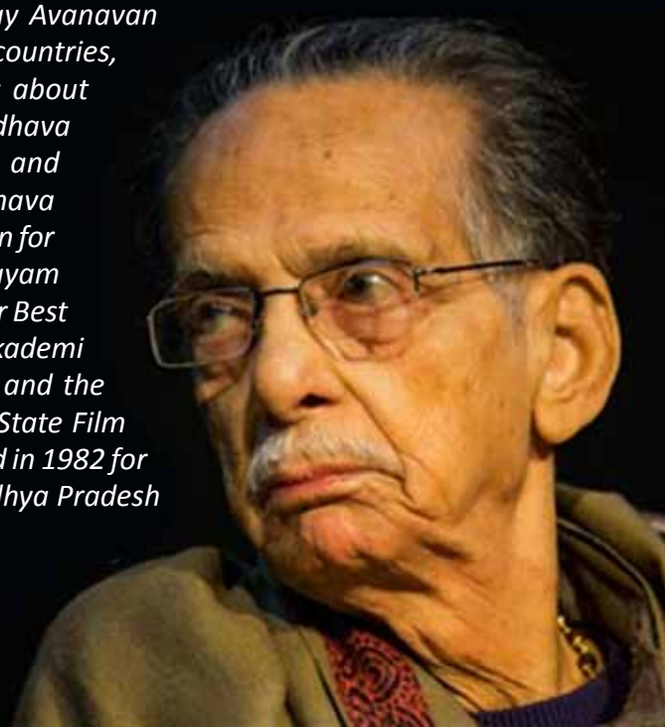
Sirumalai (AAB)

Synonym: *Uduran Vazhai*

This is exclusivity grown on *Sirumalai* hills in Dindigual district of Tamilnadu. It is considered to be an eco-type of *Virupakshi*. There is no much difference between the two. The pulp in *Sirumalai* type is not dry as in *Virupakshi* and it is juicy. This is a delicious variety with a good flavour. The fruits drop off the pedicel when fully ripe hence the name udurai, in Tamil meaning "dropping off".

Kavalam Narayan Panikkar (1928-2016)

Kavalam Narayan Panikkar who died on 26 June 2016, aged 88, was an Indian dramatist, theatre director and poet. He was born on 28 April 1928 in the village of Kavalam, into an ancient family from Kuttanad in Alappuzha, Kerala State, India. His family name is Chalayil and he is a nephew of Sardar Kavalam Madhava Panikkar and a cousin of Dr. K. Ayyappa Panicker, a Malayalam poet. In 1974, Kavalam shifted his residence to the state capital Thiruvananthapuram. In this period his play Avanavan Kadamba was filmed by G. Aravindan. He has worked in many countries, including the former Soviet Union. He has directed two movies about the greatest Kutiyattam maestro legendary actor Guru Mani Madhava Chakyar: Mani Madhava Chakyar: The Master at Work (1994) and Parvati Viraham (1993) in Kuttiyattam form featuring Mani Madhava Chakyar as Ravana. As a lyricist in Malayalam cinema, he has written for films like Ulsavapittennu, Manjadikuru (2008), Vadakakkoru Hridayam (1978) and Marmaram (1982). He won Kerala State Film Award for Best Lyrics for the latter two films. He was awarded Sangeet Natak Akademi Award in 1983 and Sangeet Natak Akademi Fellowship in 2002 and the Padma Bhushan civilian decoration in 2007. He has won Kerala State Film Award for Best Lyrics twice, in 1978 for Vadakakkoru Hridayam and in 1982 for Marmaram, and the Kalidas Samman by the Government of Madhya Pradesh in 1995.



Can Agriculture be without the plough?

Yes! It is Called Horticulture!

Organic horticulture is the science and art of growing fruits, vegetables, flowers, or ornamental plants by following the essential principles of organic agriculture in soil building and conservation, pest management, and heirloom variety preservation.

RASHMI*[1], R. AND PRADNYARANI NIDAGUNDI

1 Ph.D. Scholar (Hoticulture),
2 Ph.D. Scholar (Plant Pathology)
(College of Horticulture, UHS, Bagalkot), Karnataka - 587 104
***Email: rashmi.hortico@gmail.com**

The Latin words *hortus* (garden) and *cultura* (culture) together form horticulture, classically defined as the culture or growing of garden plants. Horticulture is also sometimes defined simply as *"agriculture minus the plough."* Instead of the plough, horticulture makes use of human labour and gardener's hand tools, although small machine tools like rotary tillers are common now.

Organic farming is a crop production method respecting the rules of the nature. The British botanist, Sir Albert Howard often called 'the father of modern organic agriculture' studied traditional farming practices in Bengal. In 1972, the International Federation of Organic Agriculture Movement (IFOAM), was founded in France, certification started in 1990.Organic farming is targeted to produce nutritive, healthy and pollution free food. It maximizes the use of on farm resources and minimizes the use of off-farm resources. It is social profit oriented, than profit oriented. In organic farming entire system i.e, plant, animal, soil, water and micro-organism are to be protected.

Organic farming provides a real opportunity for horticultural crop production, expend the food market worldwide (organically produced food has great demand in foreign countries; there is major deficiency of home produced organic fruit and vegetable in certain countries like Island), has lower cost of production and provide good price premium which may cover reductions in yield during early phase of organic farming system. It increases the opportunity of direct sale of produce e.g. Farmers Markets, Farm Shops etc. (People are now keen interested to purchase organically produced food).

General information of Organic Horticulture

Vermi-compost, mulches, cover crops, compost, manures, and mineral supplements are soil-building mainstays that distinguish this type of farming from its commercial counterpart. Through attention to good healthy soil condition, it is expected that insect, fungal, or other problems that sometimes plague plants can be minimized. However, pheromone traps, insecticidal soap sprays, and other pest-control methods available to organic farmers are also sometimes utilized by organic horticulturists.

Horticulture involves five areas of study. These areas are floriculture (includes production and marketing of floral crops), landscape horticulture (includes production, marketing and maintenance of landscape plants), olericulture (includes production and marketing of vegetables), pomology (includes production and marketing of fruits), and post-harvest physiology (involves maintaining quality and preventing spoilage of horticultural crops). All of these can be, and sometimes are, pursued according to the principles of organic cultivation.

ADVERSE IMPACT OF GREEN REVOLUTION (1967-1977)

1. Soil fatigue due to intensive cultivation.
2. Stagnation of HYV yield.
3. Decrease in input use efficiency.
4. Declining water table.
5. Increase susceptibility to pest & diseases.
6. Pest becoming tolerant to pesticides.
7. Increased soil salinity.
8. Serious imbalance in nutrient status.
9. Deficiency in secondary & micronutrients i.e. Sulphur, Zinc, Boron, Iron, Manganese, Molybdenum including universal deficiency of NPK.
10. Nitrate contamination in ground water.
11. Accumulation of heavy metals like Arsenic, Lead & Cadmium.
12. Presence of pesticide residue in food material and milk sample.

APPROACHES FOR ORGANIC FARMING

1. Nature farming;- 'do nothing' approach
2. Ecological agriculture;- tools used are biofertilizers , botanical pesticides, bio-control agents, stress resistant varieties, vermi-compost etc.
3. Rishi krishi;-angara - bhoomi sanskar, to make soil fertile.

- amrit pani - for seed treatment.
- pancha gavya - for vegetative and reproductive growth.
- biodynamic farming - for micronutrient supply.

Organic horticulture (or organic gardening) is based on knowledge and techniques gathered over thousands of years. In general terms, organic horticulture involves natural processes, often taking place over extended periods of time, and a sustainable, holistic approach-while chemical-based horticulture focuses on immediate, isolated effects and reductionist strategies.

Organic practices arise from the understanding that all organisms in nature are interdependent, and in order to have healthy plants we must foster the health of their entire ecosystem. These practices go beyond integrated pest management, beyond the use of so-called

Objectives of Organic Farming

1. To produce healthy, nutritious and quality food.
2. To maintain and enhance long-term fertility of soils.
3. To encourage and enhance biological cycles involving microorganisms, soil flora and fauna, plants and animals.
4. To help in soil and water conservation.
5. To minimize all forms of pollution that may result from agricultural practices.
6. To use on farm resources as far as possible.
7. To maintain genetic diversity.
8. To preserve and enhance traditional and indigenous knowledge in farming, varieties.

Why Organic Farming...?

1. Use of pesticides in the world has registered ten fold increase from 1945 to 1975. In India, about 80,000 tonnes of pesticides are used.
2. Fertilizer consumption has also been increased substantially.
3. The pesticides and fertilizers persist in the soil which are harmful to the beneficial soil micro-organism and earthworms and thereby resulting in degradation of soil fertility.

organic fertilizers and pesticides. They acknowledge the concept of intrinsic health, and seek to create environments that cater to the well-being of all their inhabitants.

Organic gardening systems

There are a number of formal organic gardening and farming systems that prescribe specific techniques. They tend to be more specific than, and fit within, general organic standards. Biodynamic farming is an approach based on the esoteric teachings of Rudolf Steiner. The Japanese farmer and writer Masanobu Fukuoka invented a no-till system for small-scale grain production that he called Natural Farming. French intensive and biointensive methods and SPIN Farming (Small Plot INtensive) are all small scale gardening techniques.

A garden is more than just a means of providing food, it is a model of what is possible in a community- everyone could have a garden of some kind (container, growing box, raised bed) and produce healthy, nutritious organic food, a farmers market, a place to pass on gardening experience, and a sharing of bounty, promoting a more sustainable way of living that would encourage their local economy. A simple 4' x 8' (32 square feet) raised bed garden based on the principles of bio-intensive planting and square foot gardening uses fewer nutrients and less water, and could keep a family, or community, supplied with an abundance of healthy, nutritious organic greens, while promoting a more sustainable way of living.

Other methods can also be used to supplement an existing garden. Methods such as composting, or vermin-composting. These practices are ways of recycling organic matter into some of the best organic fertilizers and soil conditioner. Vermi-compost is especially easy. The by product is also an excellent source of nutrients for an organic garden.

Can they Unite...

Industry, Agriculture and Forestry?

Agro-forestry lays its very foundation on the simultaneous usage of land under trees and crops such that yield will be comparatively more than the individual entity either tree or crop and it has been proven too. Industrial agro-forestry is of the same model of home-gardens with additional input and linkage from research institutes and industries.

S.SURESH RAMANAN

M.Sc (Forestry), Department of Silviculture and Agroforestry, College of Forestry, Kerala Agricultural University.
Email: sureshramanan01@gmail.com

Wood is need for development; it is used in many forms in our day to life from a paper to pencil. Even though plastics and iron have been alternatives for wood in certain aspects yet our demand for wood kept on increasing. India is one among the few countries that have banned the felling in natural forest- Forest Conservation Act, 1980 and National Forestry Policy, 1984. So readers should wonder where from the wood that we use comes from. The wood that we use mostly for our furniture is from imports, small timbers from TOF (Trees Outside the Forest) including tree from farmer's field and some illegal felling. As major part of our demand is supplied through the imports leading to loss in forest revenue. So to save forest reserves, we have to find source of supply - *Industrial agro-forestry* is suffice for it.

The pressure on the land is of greater

extent that area under agriculture is declining and land-holding per farmer is also small will be the criticism put forth for tree growing on plantation scale. As such agro-forestry lays its very foundation on the simultaneous usage of land under trees and crops such that yield will be comparatively more than the individual entity either tree or crop and it has been proven too. For Kerala home-gardens, a typical example for agro-forestry systems is an internationally renowned sustainable farming model. Industrial agro-forestry is of the same model of home-gardens with additional input and linkage from research institutes and industries. A typical well performing example of industrial agro-forestry is practiced in Tamil Nadu with collaboration of farmers, research institution and industries as a Consortium for Industrial Agro-forestry operating on modified model of contract farming called *'Quad-Partite Model Contract Farming'.*

Modus operandi

The operation of each of the component can be briefed. It is the active interaction between the farmer and research institutions leading to success. The active role of research institute was played by Forest College and Research Institute, Tamil Nadu Agricultural University collaborating with the TNPL (Tamil Nadu Newsprint Limited), public limited enterprise, SPB paper mills and other industries, has turned lives of many farmers. The institution has released variety and clones in trees such that they meet the quality requirement of the industries so that they procure it. Farmers get the financial input and technical input from financial institutions and research institutions as there is assured buy-back from industries, the agricultural intercrop that they grow in between trees is an added-revenue for them. The trees are harvested depending upon the industrial requirement and species.

Trees species and intercrops

Casuarina(Chavakkamaram), Meliadubia (Malei-vembu) and *Eucalyptus* are grown along with

S.No.	Species- variety	Details
1.	Casuarina MTP 2 (2010) (for pulping purpose)	Rotation : 24 months-36 months Yield/ ha: 15 tonnes/ ha B:C ratio: 3.88
2.	MeliadubiaMTP 1 (2012) (for plywood and biomass energy)	Rotation: 5-6 years Yield/ ha: 4000 cu. Ft/ ha B:C ratio : 4.28

*B:C Ratio- Benefit cost Ratio.

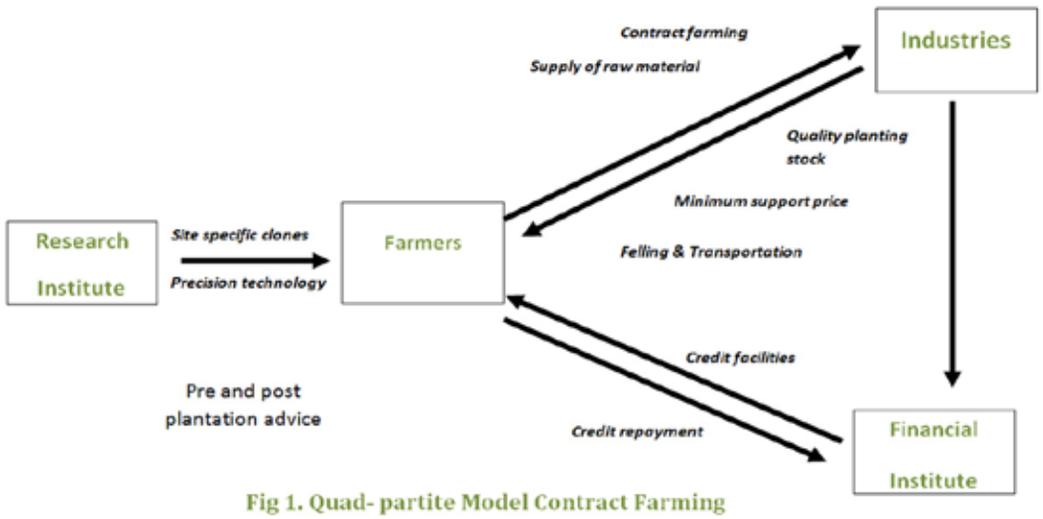


Fig 1. Quad- partite Model Contract Farming

intercrop such as banana, green leafy vegetables, pulses and even some flowers. As variety released by the institutions provide a better yield - FCRI MTP *1 Meliadubia, FCRI MTP 2 Casuarina* are variety that has been used by the farmers. Apart from this other species such as *Acrocarpus fraxinifolius, Dalbergia sissoo, Gmelina arborea, Ailanathus excelsa* are also grown.

Success of Tree growing

Currently the demand for wood by the industries are met by two supply chain systems, viz., Forest Development Corporation and farmer's supply. The remaining raw material comes from the farm lands through the traders. The supply chain of farm forestry is depicted (Fig 2.).

In the existing supply chain, growers sell the whole plantation on the acreage basis not taking into consideration the actual volume of the growing stock, which resulted in minimal returns to the growers and middle man phenomenon with lack of improved technological input has been barring farmers to go for tree growing, but now once these issues are addressed.

Research institute contribution to this model should appreciated and this may be taken as an example for prompting more farmers oriented research in SAU's (State Agricultural University). For such institutions are facilitating farmers in the state of Tamil Nadu who are known as Tree Growers.

Tree growing can support any farmer- rich or poor and can increase their livelihood and profit. On one condition that progressive technological input and proper silvicultural practices should be adopted as it is the key for sustainable development.

Reference

FCRINAIP *[Forest College and Research Institute-National Agricultural Innovation Project]*. 2016. Website: http://www.fcrinaip.org/

Ramasamy, K. 2014. *Industrial Agroforestry:* A Successful Value Chain Approach in Tamil Nadu, Indian Farming. 63(11): 30–32.

KNOW THE RODENTS

to manage them..

When it comes to reality, rodent control is a very difficult and tricky affair as they are highly adaptable and most intelligent crop pests. Moreover they act as carriers of many zoonotic diseases like plague, yellow fever, leptospirosis and Hanta virus. An understanding of their behaviour is essential for effective implementation of control measures.

MANJUSHA R. S.

Agricultural Officer
Krishibhavan, Nadathara, Thrissur Dist
Email: manjusha4112@gmail.com

Dr. P. SAKTHIVEL

Assistant Scientific Officer (Vertebrate Pest Management)
National Institute of Plant Health Management (NIPHM), Hyderabad

"I think mice are rather nice. Their tails are long ,their faces small. They haven't any chins at all. Their ears are pink, their teeth are white, they ran about the house at night. They nibble things but shouldn't touch and no one seems to like them much. But i think mice are nice.." - Rose Fyleman (Nursery rhyme)

As in the poem, are they nice? May be for the pet lovers and the Mickey mouse's fans! Surely for most people they are not at all appealing. Because they destroy grains, foodstuffs, damage materials and burrow the basement of buildings. Mice, rats and bandicoots are commonly called as rats. But they are different and along with porcupines and squirrels belong to the order Rodentia which is the largest group among mammals.

Considering the extent of damage caused, rodents are behind insects, diseases and weeds. Still it comes to six percent which turns out to be a huge monetary loss. They damage food and grains not only by feeding and but also by soiling with excreta. Moreover they act as carriers of many zoonotic diseases like Plague, Yellow fever, Leptospirosis and Hanta virus .

When it comes to reality, rodent control is a very difficult and tricky affair as they are highly adaptable and most intelligent crop pests. Being a vertebrate, they have brain and strong memory power which help them to think and escape from poison and traps. An understanding of their behaviour is essential for effective implementation of control measures.

Ever growing incisors: Their front two incisor teeth are growing continuously which tempt them to gnaw things. This strong weapon makes them a highly destructive pest.

Fossoriality: Indicates that they live in burrows/crevices except the house rat and squirrels that make nests. Within the burrows constant environmental conditions are maintained as soil does not permit much heat fluctuations. They adjust the depth of burrows to adjust internal temperature. Based on the nature of the burrow the rodent type can be easily identified. Porcupines

occupy crevices, bandicoots scoop soil before burrows and the soft furred field rat makes vertical burrows.

Nocturnality : They are nocturnal or active at night. More correctly they are crepuscular (active at dawn and dusk).

Exploration : Rodents have the inborn instinct to continuously check their surroundings mostly during dawn and dusk to find whether there is any change. This helps them to spot the changes easily and escape from enemies and traps.

Theigmotaxis : They have a very peculiar movement. They prefer to move aligning vertical surfaces. Field rats and bandicoots move at the base of bunds and house rat aligning the walls. This habit is important in deciding the position of baits, if the baits are placed on the bund or the centre of the room will not be accepted in most cases.

Neophobia : It is the fear of new things or the avoidance of new things or changes in the surrounding environment. This instinct prevents them from being attracted to bait and will not enter a new trap. When a new food item is given they will not eat it readily, but mark it and taste it. Neophobic period for house rat and lesser bandicoot rat is three days, for the Indian mole rat it is one day. So at first, the baits have to be placed without poison and if the rat accepts it, poison can be added after the neophobic period.

Baitshyness : It is the aversion towards the poison bait. If the first dose of an acute poison like Zinc phosphide does not kill the animal but causes discomfort in stomach, the rodents are intelligent enough to associate this discomfort with the bait material they ate. Consequently they avoid eating that particular food item. Though it is considered as a temporary phenomenon, can last upto 21 days in lesser bandicoot and 75 days in house rat and large bandicoot.

Anticoagulant resistance: Chronic rodenticides (poison that kills slowly over a period of time) like warfarin are reported to result in resistance development in rodents when several generation are continuously exposed to it. Anticoagulants kill by preventing blood clotting.

Bouncing effect of breeding: Rodents have high reproductive capacity. Each female produces about six young ones normally. But when food is abundant or when their population reduces abnormally they go for abnormal breeding. In abnormal breeding a female can produce up to 20 offspring within one and a half months. Female uterus structure is favourable and expands to carry many embryos. There are many physio-biological effects which help rodents to safe guard their population.

Migration: Rodents migrate to favorable shelter based on the availability of food. In rice cropped area, they establish their burrows at maximum tillering stage multiply sufficiently and emigrate after the crop harvest.

The success of any rodent control programme depends on understanding the above basic behaviours of rodents and manipulating the behaviour by taking appropriate measures to avoid them as pest.

NEWS Desk

Kuttanad Package Sumitted to Centre

State Minister for Agriculture Development and Farmers Welfare Shri. V. S. Sunilkumar stated that the government would take all necessary steps to submit kuttanad package Rejuvenation project to the central government. He was visiting the Rani-Chithra Backwaters and Kainakari, Kuppappuram Paddy fields

Horticorp will be collecting vegetables from farmers directly

State Minister for Agriculture Development Farmers Welfare Shri. V. S. Sunilkumar stated that the government would take all steps to collect vegetable products directly from the farmers. He was mangurating state-wide programme ensuring vegetables at 30% reduction in price than market price, at Trivandrum Sasya Super Market.

Farmers Meet at Alappuzha

State Minister for Agriculture Development and Farmers' Welfare Shri. V. S. Sunilkumar inagurated the meet of vegetable farmers of Alappizha district. He also distributed awards to farmers who performed best at the district level. Adv. U. Prathibha Hari, Shri. R. Rajesh, Mavelikkara MLA, Shri. Ashokkumar Thekkan, Director, Department of Agriculture and Farmers Welfare, Smt. Rajani Jeyadev, Bharanikkav Block Panchayat President, Prof. V. Vasudevan, Bharanikkav Grama Panchayat President and Shri. J. Premkumar, Principal Agriculture Officer, Alappuzha were present.

CLIMATE CHANGE: INDIA PLANS WOMEN-FRIENDLY AGRICULTURAL EQUIPMENT

Men are migrating to cities, leaving behind women in villages. That's impacting agriculture as women find it difficult to use heavy equipment used for farming. But that is going to change as the government plans to develop women-friendly equipment to sustain agriculture. The capacity of women has to be enhanced to sustain agriculture in the country in view of demographic and socio-economic changes in rural areas due to climate change. Mechanization development division of the agriculture ministry and Indian Council of Agriculture Research (ICAR) are working together to innovate women-friendly agriculture equipment. Changes in temperature and precipitation, increased frequency of extreme events such as drought and floods, as well as the accelerated melting of the Himalayan glaciers have raised concerns about the future of agriculture and food production, and its ability to keep up with the growing demands. Experts have repeatedly said that men are migrating from the rural areas due to climate change. Majority of people in the Himalayan region live in rural areas and depend on agriculture for their livelihood. Climate change, population growth, rural-urban migration and other socio-economic changes have impacted agriculture. Keeping that in mind, the government has now stepped in to ensure that even if men migrate, women in the rural areas take up agriculture. The focus is on these women whose hard work will drive this sector in the future. It's a step to secure our food plate.

WORLD POPULATION DAY: 11 JULY

World Population day is an annual event, observed on July 11 every year, which seeks to raise awareness of global population issues. The event was established by the Governing Council of the United Nations Development Programme in 1989. It was inspired by the public interest in *Five Billion Day* on July 11, 1987-approximately the date on which the world's population reached five billion people. The world is seeing a record number of people displaced by crises, some 60 million according to the latest UN figures. UNFPA works in emergency settings around the globe to respond to the rights and needs of women and girls, helping them maintain their dignity, securing their safety, and restoring their access to sexual and reproductive health care. As the world population edged to 7 billion people in 2011 (up from 2.5 billion in 1950), it has had profound implications for development. A world of 7 billion is both a challenge and an opportunity with implications on sustainability, urbanization, access to health services and youth empowerment. In 1989, in its decision 89/46, the Governing Council of the United Nations Development Programme recommended that, in order to focus attention on the urgency and importance of population issues in the context of overall development plans and programmes and the need to find solutions for these issues, 11 July should be observed by the international community as World Population Day. The General Assembly has asked the UN Population Fund (UNFPA) to undertake activities aimed at building better awareness of population issues, including their relation to environment and development issues and World Population Day.

Website: http://www.unfpa.org

WORLD HEPATITIS DAY- 28 JULY

World Hepatitis Day, observed on July 28 every year, aims to raise global awareness of hepatitis, a group of infectious diseases known as Hepatitis A, B, C, D, and E and encourage prevention, diagnosis and treatment. Hepatitis affects hundreds of millions of people worldwide, causing acute and chronic disease and killing close to 1.4 million people every year. Approximately 500 million people worldwide are living with either hepatitis B or hepatitis C. If left untreated and unmanaged, hepatitis B or C can lead to advanced liver scarring (cirrhosis) and other complications, including liver cancer or liver failure. While many people worry more about contracting AIDS than hepatitis, the reality is that every year 1.5 million people worldwide die from either hepatitis B or C faster than they would from HIV/AIDS. Hepatitis groups, patients and advocates worldwide take part in events on 28 July to mark the occasion. Notably in 2012, a *Guinness World Record* was created when 12,588 people from 20 countries did the *Three Wise Monkeys* actions on World Hepatitis Day to signify the willful ignorance of the disease. World Hepatitis Day provides an opportunity to focus on actions such as: Raising awareness of the different forms of hepatitis and how they are transmitted; Strengthening prevention, screening and control of viral hepatitis and its related diseases; Increasing hepatitis B vaccine coverage and integration into national immunization programmes; and Coordinating a global response to hepatitis. Each year focuses on a specific theme. World Hepatitis Day is one of eight official global public health campaigns marked by the World Health Organization (WHO), along with World Health Day, World Blood Donor Day, World Immunization Week, World Tuberculosis Day, World No Tobacco Day, World Malaria Day and World AIDS Day. The theme for this year's World Hepatitis Day is *"Prevent hepatitis. Act now".*

Website: http://worldhepatitisday.org/

STATE FISHES

T.D. VELAYUDHAN

Joint Director (Retd) Department of Fisheries
Government of Kerala
Email: tdvelayudhan@gmail.com

State Arunachal Pradesh, Himachal Pradesh, Uttarakhand and Jammu & Kashmir

Fish Golden Mahseer

Order	:	Cypriniformes
Family	:	Cyprinidae
Scientific name	:	*Tor putitora*
Trade name	:	Golden Mahseer
Local Name	:	*Mahseer, Junga pithia, Pithia*

Distribution : Distributed in the streams and rivers of Eastern and Western Himalayas. Reported to occur in Utter Pradesh, Uttarakhand, Madhya Pradesh, Punjab, Jammu & Kasmir, Arunachal Pradesh, Himachal Pradesh, Assam & Karnataka. Also found in Pakistan, Bangladesh & Nepal.

Colour : The fish has a characteristic but attractive colour on the abdomen and head. Scales above the lateral line golden with dark base. Fins are generally yellow in colour, the lower ones often tinged orange. Iris golden. Lateral line complete with 25-28 scales.

Habit & habitat : Inhabits the freshwater bodies in the mountain and sub-mountain regions particularly in rapid streams with rocky bottom, riverine pools and lakes. It is the most sought after game fish for anglers across the world.

Food and feeding : The fish is a column feeder with omnivorous nature during adult stage and feed on periphytic algae and diatoms in juvenile stage. The breeding and feeding habitats are lost almost throughout their distribution range.

Breeding behaviour : It grows to attain maturity in large rivers, migrates to headwaters, streams and creeks to spawn three times a year: January-February, May-June and July-September. Fecundity is very low compared to carps. It's captive breeding practices standardized. Commercial hatcheries to be developed for the assured seed supply for aquaculture and ranching.

Golden Mahseer : Traditional people use the blood of cut fish in foot and mouth disease. It is also applied on sore wounds in legs.

Conservation : According to the assessment of IUCN Mahseers are endangered due to over fishing and loss of habitat. Strategies for the preservation of existing habitats, development of seed production technology for restocking and culture have to be developed for the promotion of Mahseer wealth.

Cuisine

INDU NARAYAN
Email: indunarayan@gmail.com

Ramadan Special

Corn Rolls

Ingredients:

1) 1 cup par-boiled andcrushed corn kernels
2) ½ cup par-boiled corn kernels
3) 4 hard boiled Potatoes
4) 2 tsp corn flour
5) 3-4 slices of bread
6) 5-6 pods of garlic
7) 1" piece ginger
8) 3-4 green chillies
9) ½ tsp black salt
10) ½ tsp black pepper powder
11) ½ tsp sugar
12) ¼ tsp red chilli powder
13) Salt to taste
14) ½ cup Coriander leaves
15) oil for frying

Method:-

In a large mixing bowl, mash the hard boiled potatoes, crushed corn and whole corn kernels. Crush garlic, ginger and chillies in a mixi and add to it. Add finely chopped Coriander and the seasonings viz. salt, black salt, gingar, black pepper powder, red chilli powder and mix well. Add the corn flour and bread slices and combine the same well. Make small balls out of it and press the tooth pick into it like a lollipop.

Heat oil in a vessel and deep frying them on high flame till brown.

Serve hot with tomato ketchup.

Crab Cake

1 Crab meat- 1 pound (about ½ Kg)
2. ½ onion, finely chopped
3. Potato
4. Clover, garlic - minced
5. ½ tsp cumin seeds
6. 1 egg
7. 1tsp chilli powder
8. ¼ tsp garam masala
9. Handful of Coriander leaves, finely chopped
10. 2tsp bread crumbs.

Method:-

Boil the crab, remove the meat out and keep it aside. Boil potato and keep it aside.

Heat oil in a pan and saute the onions and garhi. Take a mixing bowl, add the santed onions and garhi. Also add boiled potato, shredded Erab meat, Cumin seeds and Coriander leaves. Add salt, chilli powder, garam masala and an egg. Mix everything together. If the mixture becomes moistened add bread crumbs. Make equal sized crab meat balls and then shape them as cutlets. Heat a griddle and pour few drops of oil and fry them.

Crab cake is ready. Serve as a snack or Ramzan day.

KERALA KARSHAKAN *English journal*
The first English Farm Journal from Kerala

Published by S. Suresh Kumar, Owned by Department of Agriculture,Government of Kerala and
Published at Farm Information Bureau, Kowdiar P.O, Thiruvananthapuram-3. Editor Ida Samuel