VIVEKANANDA COLLEGE

College with Potential for Excellence

Residential & Autonomous- A Gurukula Institute of Life Training
Re-accredited "A" Grade (3rd Cycle) by NAAC (CGPA 3.59 out of 4.0)
Affiliated to Madurai Kamaraj University
Managed by Sri Ramakrishna Thapovanum , Tiruparaithurai, Trichy

Tiruvedakam west, Madurai – 625 234, Tamil Nadu, India

DEPARTMENT OF BOTANY

SUMMER TRAINING PROGRAMME

(Under DBT Star College Scheme)

Organic Gardening for Sustainable Development and Identification of Wild Vegetables

Date : 11th – 15th July 2022 | Venue: Department of Botany

Mr. P. Saravanan (02.00 pm – 03.00 pm)
Director, Rasi Organic Farms
(Manufacture of Vermicompost and Organic Manures)
Pandiarajapuram, Vadipatti 625218, Madurai

Topic: Preparation of Vermicompost and organic manures

Day 5: Friday, 15.07.2022

Dr. G. Muralitharan (10.00 am – 11.00 am & 11.15 am – 12.15 pm)
Associate Professor, Department of Microbiology
Bharathidasan University, Tiruchirappalli 625234

Topic: Symbiosis and molecular evolution of plants
Topic: Cyanobacteria and microalgae for next generation organic farming

Mr. S. Arivudai Nambi (02.00 pm – 03.00 pm)
Director, Evergreen Tech, South Street, Kanniyappapillipatty
Andipatty Tk, Theni Dt 625512

Topic: Methods of Preparation of Biofertilizer

Valedictory Address (3.30 pm - 4.00 pm)

Prayer	Om Shahanavavathu
Welcome Address	Dr. V. Ramesh, Assistant Professor & Head
Presidential Address	Dr. T. Venkatesan, Principal
Vote of Thanks	Dr. C. Soundar Raju, Assistant Professor
Prayer	Om Sarvae Bavanthu

Organizing Committee

Dr. G. Ponraj
Associate Professor & Coordinator
-DBT Star College Scheme
-Department of Zoology

Dr. V. Ramesh
Head & Convener
Department Coordinator
- DBT Star College Scheme
Department of Botany

Dr. C. Soundar Raju
Assistant Professor & Organizing Secretary
Department of Botany

Dr. T. Sellathurai
Assistant Professor & Member
Department of Botany

Dr. V. Kumarasamy
Assistant Professor & Member
Department of Botany

Inaugural Address (10.00 am – 11.00 am)

Prayer	Om Shahanavavathu
Welcome Address	Dr. V. Ramesh, Assistant Professor & Head
Blessings	Swami Vedananda, Secretary Swami Athyadmananda, Kulapathi
Presidential Address	Dr. T. Venkatesan, Principal
Felicitation	Dr. G. Ponraj, Coordinator, DBT Star College Scheme
Vote of Thanks	Dr. C. Soundar Raju, Assistant Professor
Prayer	Om Sarvae Bavanthu

Technical Session (10.00 am – 04.00 pm)

Day 1: Monday, 11.07.2022

Dr. V. Shanmugaiah (11.15 am – 12.15 pm)
Associate Professor
Department of Microbial Technology
School of Biological Sciences
Madurai Kamaraj University, Madurai 625021

Topic: Rhizosphere microbes and their role for sustainable agriculture

Dr. K. Kannathasan (2.00 pm – 03.00 pm)
Assistant Professor, Department of Botany
Arulmigu Palaniandavar College of Arts and Science, Palani 624601

Topic: Organic Terrace garden

Dr. S. Baskaran (03.00 pm – 04.00 pm)
Assistant Professor, Department of Biotechnology
The Madura College, Madurai 625011

Topic: Bat Guano as a Biofertilizers

Day 2: Tuesday, 12.07.2022

Dr. S. Lalitha (10.00 am – 11.00 am & 11.15 am – 12.15 pm)
Associate Professor, Department of Botany
Soil Biology and PGPR Lab
Periyar University, Salem 636011

Topic: Technology approaches in plant development
Topic: Yield enhancement of Vegetable crops using microbial consortium

Dr. K. Arumugam (02.00 pm – 03.00 pm)
Assistant Director of Agriculture (Rtd)
21/3 Sevugan Chettiyar Colony, Pudur-Vandipathai
Rserve line Post, Maurai 625014

Topic: Garden types and its uses

Dr. R. Sathish Kumar (03.00 pm – 04.00 pm)
Assistant Professor, Department of Botany
Jamal Mohamed College, Tiruchirappalli 620020

Topic: Nutritive values of wild vegetables

Day 3: Wednesday, 13.07.2022

Dr. Ponmurugan (10.00 am – 11.00 am & 11.15 am – 12.15 pm)
Associate Professor, Department of Botany
Bharathiar University, Coimbatore

Topic: Biofertilizers in plantation crops for increased productivity and soil health

Topic: Evaluation of actinomycetes for the biological control of rhizome rot disease in plants

Mr. J. Subburaj (02.00 pm – 03.00 pm)
Organic Farmer
J. S. Bharathi Organic Farm
A. Ammapatti, Thrimangalam, Madurai

Topic: Organic gardening of fruit yielding plants

Day 4: Thursday, 14.07.2022

Mr. M. Prakash (10.00 am – 11.00 am)
Assistant Horticulture Officer
Centre of Excellence for Vegetables
Reddiyarchatram 624622, Dindigul

Topic: Nursery management

Mr. C. Ayyappan (11.15 am – 12.15 pm)
Junior Research Fellow
Centre of Excellence for Vegetables
Reddiyarchatram 624622, Dindigul

Topic: Cultivation and Management of Vegetable crops

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TIRUVEDAKAM WEST, MADURAI DISTRICT – 625 234, TAMIL NADU

DEPARTMENT OF BOTANY

Organized

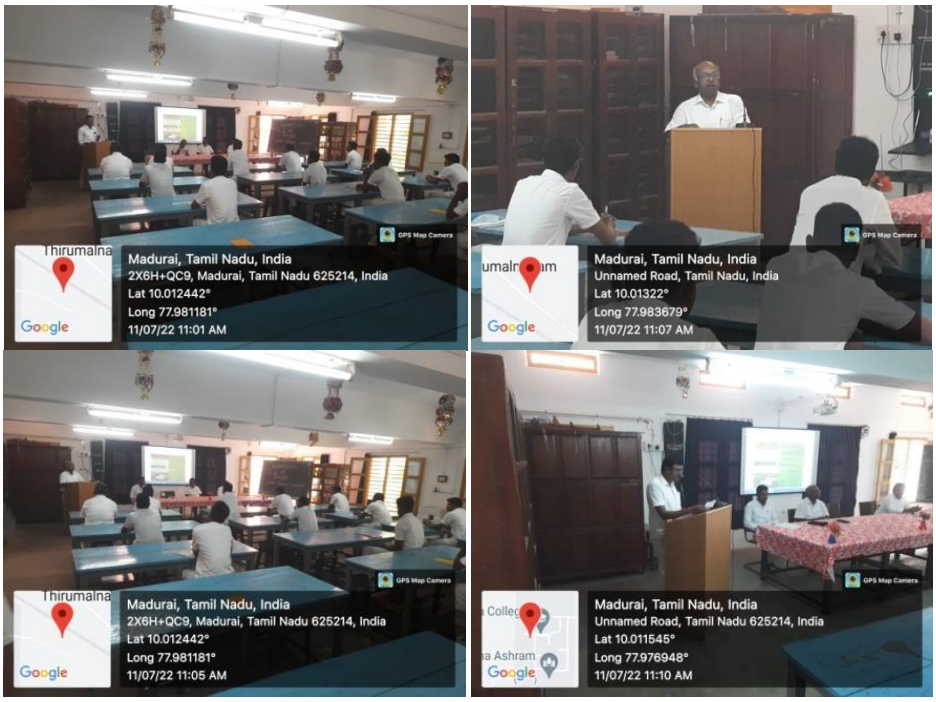
SUMMER TRAINING PROGRAMME

(Under DBT Star College Scheme)

Organic Gardening for Sustainable Development and Identification of Wild Vegetables

PROGRAMME REPORT

Inaugural Address: The Department of Botany organized a Five day summer training programme titled "Organic Gardening for Sustainable Development and Identification of Wild Vegetables" during the period of 11th to 15th July 2022. Prgramme was started with prayer "Om Shahana Vavathu" and blessings of Swami Vedananda, Secretary and Swami Adyathmananda, Kulapathi. Dr. V. Ramesh, Head & Department Coordinator welcomed the gathering and proposed about the training programme. Dr. T. Venkatesan, Principal delivered the presidential address and highlight the needs of organic gardening and nutritive values of wild vegetables and Dr. G. Ponraj, Coordinator, DBT Starch College Scheme proposed the felicitation address.



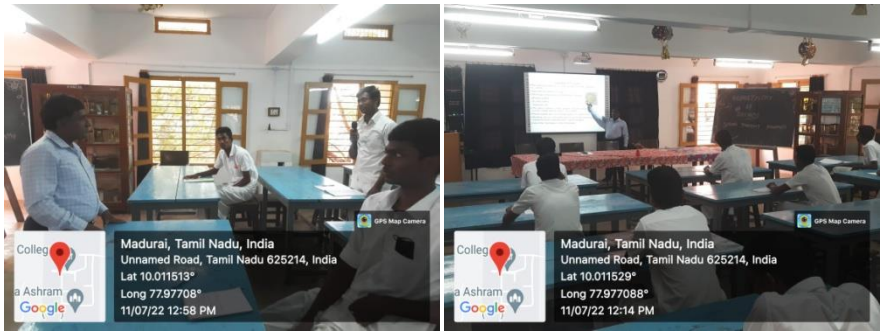
Inauguration address: Dr. V. Ramesh, Head of the Department, Dr. T. Venkatesan, Principal and Dr. G. Ponraj, Coordinator, DBT Star College Sheme

Technical Session: In this training programme discussed about production of bio-fertilizer, identification of plant beneficial microorganisms and organic cultivation practices. In this event also discussed the identification methods and nutritive values of wild vegetables for enriched quality food on human consumption. Organic farming is an eco-friendly, we use animal and plant based organic nutritive fertilizers to enrich soil fertility that are essential for crop cultivation. Organic agriculture is an efficient and promising agricultural system for environmental sustainability as it provides yield stability, improves soil health, no environmental harmfulness. Sustainable development and Organic farming provide organic food does not harm our ecosystem. Identification of wild vegetables is vital that you can utilize the edible plants. Wild plants are highly nutritious and can be even more nutritious than many cultivated domestic fruits and vegetables. The programmed scheduled with following Technical sessions and eminent resource persons.

Programme Schedule:

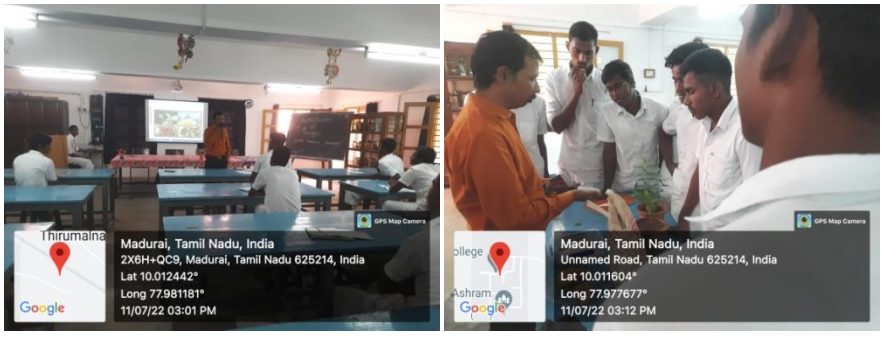
Day 1: Monday, 11.07.2022

Technical Session 1 : 11.15 am – 12.15 pm
Topic : Rhizosphere microbes and their role for sustainable agriculture
Resource Person: **Dr. V. Shanmugaiah**
Associate Professor, Department of Microbial Technology
School of Biological Sciences
Madurai Kamaraj University, Madurai 625021



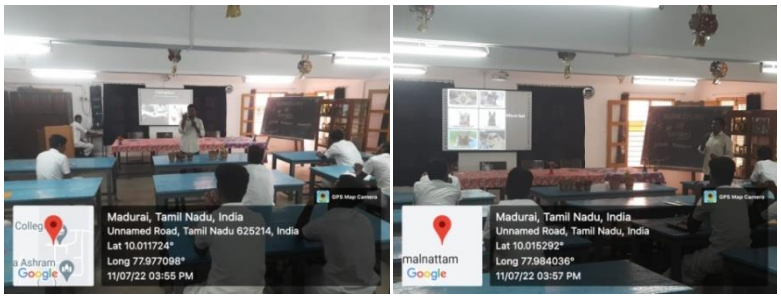
Technical session was delivered by Dr. V. Shanmugaiah, Associate Professor

Technical Session-2: 2.00 pm – 03.00 pm
Topic : Organic Terrace garden
Resource Person: **Dr. K. Kannathasan**
Assistant Professor, Department of Botany
Arulmigu Palaniandavar College of Arts and Science,
Palani 624601



Dr. K. Kannathasan, Assistant Professor handled a session for identification of wild seeds

Technical Session-3 : 03.00 pm – 04.00 pm
Topic : Bat Guano as a Biofertilizers
Resource Person: **Dr. S. Baskaran**
Assistant Professor, Department of Biotechnology
The Madura College, Madurai 625011

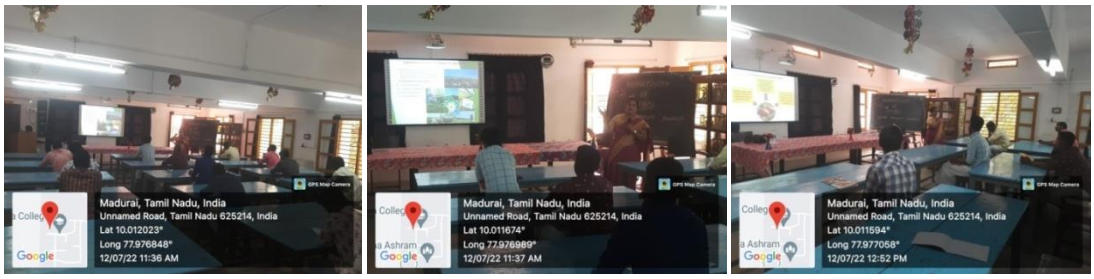


Dr. S. Baskaran, Assistant Professor given a lecture on Biofertilizers

Day 2: Tuesday, 12.07.2022

Technical Session-4 : 10.00 am – 11.00 am
Topic : Technology approaches in plant development

Technical Session-5 : 11.15 am – 12.15 pm
Topic : Yield enhancement of Vegetable crops using microbial consortium
Resource Person: **Dr. S. Lalitha**
Assistant Professor, Department of Botany
Soil Biology and PGPR Lab, Periyar University, Salem 636011



Technology approaches and yield enhancement of vegetables was delivered by
Dr. S. Lalitha, Associate Professor

Technical Session-6 : 02.00 pm – 03.00 pm
Topic : Garden types and its uses
Resource Person: **Dr. K. Arumugam**
Assistant Director of Agriculture (Rtd)
21/3 Sevugan Cettiyar Colony, Pudur-Vandipathai
Reserve line Post, Madurai 625014


Dr. Dr. K. Arumugam, Assistant Director of Agriculture (Rtd) was discussed on types of garden

Technical Session-7 : 03.00 pm – 04.00 pm
Topic : Nutritive values of wild vegetables
Resource Person: **Dr. R. Sathish Kumar**
Assistant Professor, Department of Botany
Jamal Mohamed College, Tiruchirappalli 620020

Dr. R. Sathish Kumar, Assistant Professor presented Nutritive values of wild vegetables

Day 3: Wednesday, 13.07.2022

Technical Session-8 : 10.00 am – 11.00 am
Topic : Biofertilizers in plantation crops for increased productivity and soil health

Technical Session-9 : 11.15 am – 12.15 pm
Topic : Evaluation of Actinomycetes for the biological control of rhizome rot disease in plants
Resource Person: **Dr. Ponmurugan**
Associate Professor, Department of Botany
Bharathiar University, Coimbatore

Dr. Ponmurugan, Associate Professor discussed role of Actinomycetes

Technical Session-10 : 02.00 pm – 03.00 pm
Topic : Organic gardening of fruit yielding plants
Resource Person: **Mr. J. Subburaj**
Organic Farmer, J. S. Bharathi Organic Farm
A. Ammapatti, Thrimangalam, Madurai

Mr. J. Subburaj, Organic Farmer handled the hands on training on preparation of Panchagavya

Day 4: Thursday, 14.07.2022

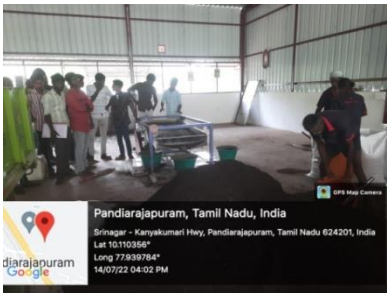
Technical Session-11 : 10.00 am – 11.00 am
Topic : Nursery management
Resource Person: **Mr. M. Prakash**
Assistant Horticulture Officer
Centre of Excellence for Vegetables
Reddiyarchatram 624622, Dindigul

Students were visited Centre of Excellence for Vegetables, Reddiyarchatram and session was handled by Mr. M. Prakash, Assistant Horticulture Officer

Technical Session-12 : 11.15 am – 12.15 pm
Topic: Cultivation and Management of Vegetable crops
Resource Person: **Mr. C. Ayyappan**
Junior Research Fellow
Centre of Excellence for Vegetables
Reddiyarchatram 624622, Dindigul

Mr. C. Ayyappan, Junior Research Fellow given the technology on Nursery Managment

Technical Session-13 : 02.00 pm – 03.00 pm
Topic : Preparation of Vermicompost and organic manures
Resource Person: **Mr. P. Saravanan**
Director, Rasi Organic Farms
Pandiarajapuram, Vadipatti 625218, Madurai

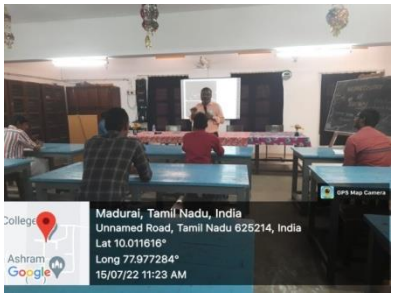


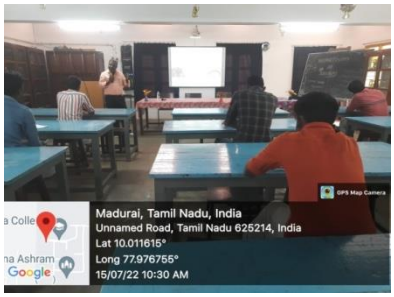
Students were visited and participated in training on vermicomosting and their benefits on soil health by Mr. P. Saravanan, Director, Rasi Organic Farms

Day 5: Friday, 15.07.2022

Technical Session-14 : 10.00 am – 11.00 am
Topic: Symbiosis and molecular evolution of plants

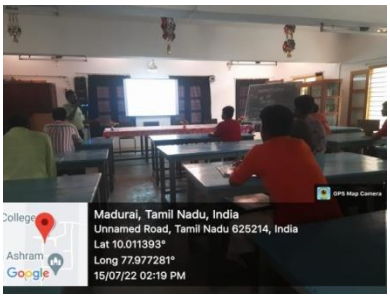
Technical Session-15 : 11.15 am – 12.15 pm
Topic: Cyanobacteria and microalgae for next generation organic farming
Resource Person: **Dr. G. Muralitharan**
Associate Professor, Department of Microbiology
Bharathidasan University, Tiruchirappalli 625234

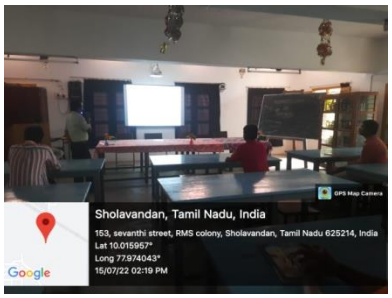




Dr. G. Muralitharan, Associate Professor discussed on benefits of microalgae on organic faming

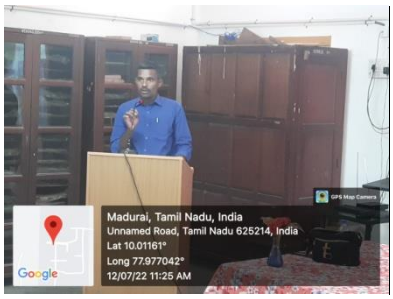
Technical Session-16 : 02.00 pm – 3.00 pm
Topic : Hands on training on Preparation of Biofertilizers
Resource Person: **Mr. S. Arivudai Nambi (02.00 pm – 03.00 pm)**
Director, Evergreen Tech, South Street, Kanniyappapillipatty
Andipatty Tk, Theni Dt 625512





Mr. Arivudai Nambi delivered on production of biofertilizers

Valedictory address: In this programme, 37 students from the science department of our college was participated and gained the knowledge on organic farming and utilization of wild vegetables. The programme was ended with the formal vote of thanks by Dr. C. Soundar Raju and the members of this programme Dr.T. Sellathurai and Dr. V. Kumarasamy co-ordinated the entire programme. The training programme was ended with closing prayer "Om Sarve Bhavanthu"



Participation of student participants and organizing committee of summer training programme

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Vivekananda College, Tiruvedakam West

Summer Training Programme

- Under DBT Star College Scheme

Organic Gardening for Sustainable Development and Identification of Wild Vegetables - Organized by Department of Botany

Sl. No	Name of the Participants	Major	Date					Signature
			11/07/22	12/07/22	13/07/22	14/07/22	15/07/22	
1	B. ANANTHKUMAR	III BOTANY	×	×	×	×	×	
2	A. ANBUSELVAM	III BOTANY	×	×	×	×	×	
3	G. CHITRASOLAI	III BOTANY	×	×	×	×	×	
4	J.S. Dhaneesh	3rd BOTANY	×	×	×	×	×	
5	G. Gopinath	III BOTANY	×	×	×	×	×	
6	D. Hari Babji	III BOTANY	×	×	×	×	×	
7	T. KALAIVANAN	III BOTANY	×	×	×	×	×	
8	MUGESH WARAN. M	III BOTANY	×	×	×	×	×	
9	G. MUKILAN	III Botany	×	×	×	×	×	
10	M. MUTHTAMIL SELVAN	III BOTANY	×	×	×	×	×	
11	S. Parameswaran.	III Botany	×	×	×	×	×	
12	Y. Bravin Kumar	III Botany	×	×	×	×	×	
13	G. Raguvaran	III Botany	×	×	×	×	×	
14	S. SANTHANA KUMAR.	III Botany	×	×	×	×	×	
15	P SHANMUGA PANDIAN	III BOTANY	×	×	×	×	×	
16	V. SURIYAVEL	III BOTANY	×	×	×	×	×	
17	A. THANGARAMU	III BOTANY	×	×	×	×	×	
18	S. Vignesh Pandi	III Botany	×	×	×	×	×	
19	V. MUTHU KARUPPAIYA	II BOTANY	×	×	×	×	×	

Sl.No	Name of the Students	Major	Date					Signature
			11/01/22	12/01/22	13/01/22	14/01/22	15/01/22	
20	G. Muthu Raman	II rd Botany	×	×	×	×	×	
21	K. NANTHA KUMAR	II rd BOTANY	×	×	×	×	×	
22	A. Rajkumar	II rd Botany	×	×	×	×	×	
23	R. Rooban	II rd Botany	×	×	×	×	×	
24	P. SARAVANAKUMAR	II rd Botany	×	×	×	×	×	
25	S. Seva Sakthi Pandiyan	II rd Botany	×	×	×	×	×	
26	S. Siva Prakash	II rd Botany	×	×	×	×	×	
27	S. Suriyan	II rd Botany	×	×	×	×	×	
28	S. Vignesh Pandi	II rd Botany	×	×	×	×	×	
29	B. Ananth	III rd zoology	×	×	×	×	×	
30	V. Vinoth Kumar	III - Zoology	×	×	×	×	×	
31	K. Arivu Raj Kannan	III - MATH	×	×	×	×	×	
32	V.T Praveen kanth	III - Maths	×	×	×	×	×	
33	R. Radhakrishnan	III - phys	×	×	×	×	×	
34	M. Bothi Sathiya Vinayakam	III - Phys	×	×	×	×	×	
35	M. Sankili Murugan	III - Chem	×	×	×	×	×	
36	S. Gnanasekaran	III - chem	×	×	×	×	×	
37	V. Prabakaran.	III - chem	×	×	×	×	×	

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DEPARTMENT OF BOTANY

SUMMER TRAINING PROGRAMME

(Under DBT Star College Scheme)

Organic Gardening for Sustainable Development and Identification of Wild Vegetables

Date : 11th – 15th July 2022 | Venue: Department of Botany

Course Material

Organic Gardening for Sustainable Development and Identification of Wild Vegetables

Organic Gardening for Sustainable Development and Identification of Wild Vegetables

Course Material

DEPARTMENT OF BOTANY

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TAMIL NADU, INDIA

Organic Gardening and Sustainable Development

Introduction

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy making arena, its entry into anonymous global market and the transformation of organic products into commodities. During the last two decades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the means for complete development of rural areas. After almost a century of neglect, organic agriculture is now finding place in the mainstream of development and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability and productivity at its core, in addition to the founders concerns for healthy soil, healthy food and healthy people.

Concept of organic farming

Organic farming is very much native to India. This concept of organic farming is based on following principles:

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.
- The entire system is based on intimate understanding of nature's ways of replenishment. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way.
- The soil in this system is considered as a living entity
- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured, at all cost.
- The total environment of the soil, from soil structure to soil cover is more important and must be preserved.

Definition

Organic farming is a method of farming system, which primarily aims at cultivating the land and raising crops in such a way, so as to keep the soil alive and in good health. It is the use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials, mostly produced *in situ* - along with beneficial microbes (biofertilizers) to release nutrients to crops, which connotes the 'organic' nature of organic farming. It is also termed as organic agriculture. In the Indian context it is also termed as 'Javik Krishi'.

Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs".

Growing Crops under Organic Management

Organic farming management is an integrated approach, where all aspects of farming systems are interlinked with each other and work for each other. A healthy biologically active soil is the source of crop nutrition, on-farm biodiversity controls pests, crop rotation and multiple cropping maintains the system's health and on-farm resource management with integration of cattle ensure productivity and sustainability. Organic management stresses on optimization of resource use and productivity, rather than maximization of productivity and over exploitation of resources on the cost of resources meant for future generations.

Management Principals

A living soil is the basis of organic farming. A live, healthy soil with proper cropping patterns, crop residue management and effective crop rotation can sustain optimum productivity over the years, without any loss in fertility. Organic farming envisages a comprehensive management approach to improve soil health, the ecosystem of the region and the quality of produce. It includes all agricultural systems that promote environmentally sound production of food and fibers. These systems take local soil fertility as a key to successful production, by respecting the natural capacity of plants, animals and the landscape; they aim to optimize quality in all aspects of agriculture and environment. A living soil can be maintained by continuous incorporation of crop and weed biomass, use of animal dung, urine-based manures (FYM, NADEP, vermicompost), biofertilisers and bioenhancers, special liquid formulations (like vermiwash, compost tea etc) during a crop's duration. As a thumb rule, crop residues should be

returned to the plot, directly or indirectly. Cattle droppings may be returned to the field as compost. As a strategy, the quantity of biomass removed for human food and fiber, cattle feed or firewood from an organic farm should be replaced with any other bio-waste on the farm. But it is important to account for it for preparing the balance sheet of nutrients for each crop being cultivated on the farm. In phosphorous-deficient and acidic soils, some quantity of mineral grade rock phosphate and lime can also be added either by direct application to the field or through addition to compost. The compost can be further enriched by incorporation of biofertilisers, microbial inoculants, etc. Special composts like biodynamic compost, cowpat pit compost, biodynamic preparations such as BD-500 and BD-501, special formulations like Panchgavya, Dashgavya, Biosol etc are also useful and ensure optimum productivity. Use of EM formulation has also been found effective in soil enrichment and compost making. For high nutrient demanding crops and for intermittent soil enrichment use of oilcakes, poultry manure, concentrated manures (mixture of oil cakes, poultry manure and rock phosphate) can also be an ideal low-cost option of manuring.

Important steps

While turning towards organic it is essential that the basic requirements of the system and the area are properly understood and long term strategies are addressed first. In most part of the country poor soil health due to loss of organic matter and soil microbial load is a major problem. Reducing water availability and increasing temperature is further adding to the problems. Too much dependence on market for supply of inputs and energy has made the agriculture a cost intensive\ high input enterprise with diminishing returns. We need to address all these concerns and develop a system which is not only productive and low cost but also resource conserving and sustainable for centuries to come. To start with, following parameters need to be addressed in first stage

- Enrichment of soil
- Management of temperature
- Conservation of rain water
- Maximum harvesting of sun energy
- Self reliance in inputs
- Maintenance of natural cycles and life forms
- Integration of animals
- Maximum reliance on renewable energy sources, such as solar power and animal power

How to achieve

- Enrichment of soil – Abandon use of chemicals, use crop residue as mulch, use organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.
- Management of temperature - Keep soil covered, Plant trees and bushes on bund
- Conservation of soil and rain water – Dig percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, dig farm ponds, maintain low height plantation on bunds.
- Harvesting of sun energy – Maintain green stand throughout the year through combination of different crops and plantation schedules.
- Self reliance in inputs – develop your own seed, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts.
- Maintenance of life forms – Develop habitat for sustenance of life forms, never use pesticides and create enough diversity.
- Integration of animals – Animals are important components of organic management and not only provide animal products but also provide enough dung and urine for use in soil.
- Use of renewable energy – Use solar energy, bio-gas and bullock driven pumps, generator and other machine.

Developing organic farm

As organic management is an integrated approach, manipulation and adoption of one or few steps may not yield significant results. For optimization of productivity all the essential components need to be developed in a systematic manner. These steps include: (i) Habitat development, (ii) on-farm facilities for input production (iii) cropping sequence and combination planning, (iv) 3-4 year rotation plan and (vi) growing of crops suiting to the region, soil and climate.

Development of farm facilities and habitat

Infrastructure: Reserve 3-5% of farm space for utilities, such as space for cattle, vermicompost bed, compost tank, Vermiwash/ compost tea unit etc. 5-7 trees should be planted only on this space, as all utility infrastructure need shade. Irrigation well, water pumping infrastructure etc can also be in this utility area. Dig some percolation tanks (7x3x3mt or of any other size depending upon the rainfall and run-off pattern) for rain water conservation (1 pit per ha) at appropriate places depending upon slope and water flow. If possible develop a farm pond

of preferably 20x10 mt size. Keep few 200 lit tanks (1 per acre) for liquid manure preparation and few containers for botanicals. For 5 acre farm, develop 1-2 vermicompost beds, 1 NADEP tank, 2 biodynamic compost beds, 2-3 compost tea/ vermiwash units, 5 liquid manure tanks, five cowpat pits and one underground cattle-urine collection tank. Efforts should also be made to produce sufficient quantities of BD-500 (cow horn manure) and BD-501 (cow horn silica). 10-12 horn products are sufficient for 5 acre farm. Use of biodynamic compost prepared with the use of BD-502-507 has also been found to be very effective.

Vermicompost

Panchagavya

Habitat and biodiversity: Management of an appropriate habitat for sustenance of different life forms is an essential component of organic farming. This can be achieved by ensuring crop diversity and by maintaining a wide variety of trees and bushes as per climatic suitability. These trees and bushes will not only ensure the nutrients from air and deep soil layers to surface layer but also attract the birds and predators, friendly insects and also provide the food and shelter. There may be some loss of productivity due to shading effect but that loss can be compensated with reduced pest problems and natural biological pest control system. In the plains, for a 10-acre farm, plant at least five to six neem trees (*Azadirachta indica*), one to two tamarind (*Tamarindus indica*), two gular (*Ficus glumerata*), eight to ten ber (*Zizyphus* Sp) bushes, one to two aonla (*Emblica officinalis*), one to two drumstick and 10–15 wild bushes. More specifically, if we classify areas into wet and dry farms, then on the wet farms there should be five to six neem trees, one to two wood apples, one to two star fruit, eight to ten guava or sour soap, three to four drumstick, one to two fig and 10–15 bushes of mulberry, star gooseberry, curry leaf etc, and on the dry farms there must be at least five to six neem, one to two bael fruit, eight to ten ber or custard apple, one to two aonla , one to two drumstick and 10–15 bushes of sasaka, nirgundi (*Vitex negundo*), *Cassia auriculata*, *C. tora*, etc. In hilly areas, *Alnus nepalensis* is considered to be a wonder tree as it fixes good amount of nitrogen. It is

being promoted in a cropping system mode particularly in northeastern India. Bushes of Prunus, oak (*Quercus glauca*), Pinus species along the farm boundary and yarrow (*Achillea millifolium*), buck wheat (*Fagopyrum esculentum*), lupin (*Lupinus sativus*), Himalayan stinging nettle (*Urtica parviflora*), marigold, etc., in between the plots invite a lot of predators and also attract a large number of pests.

Fruit orchards also need to maintain adequate diversity with at least 3-5 types of fruit plants and few non-fruit trees (as listed above). Major and minor plots should be separated by bunds about 1.5m wide and should be planted with Glyricidia, perennial Sesbania (jayanti), Leucaena leucocephala, cassia siamea, etc. The internal hedgerow should consist of perennial pigeon pea, *Crotalaria* , seasonal *Sesbania*, etc. Lops from these trees will provide enough quantity of biologically fixed nitrogen. In between *Glyricidia/Sesbania* rows insert few plants of pesticidal value such as *Adathoda vesica, Vitax nigundo, Calotropis, Datura alba, Ipomea* (Besharam) etc. Surrounding the farm or garden, there should be hedgerows or a live fence of coppiced or pollarded, multipurpose, deep-rooted trees and shrubs and medicinal herbs such as *Adathoda vasica*, *Vitex negundo*, *Jatropha curcas*, etc. Ecological diversity is an essential component of any successful organic farming system. Trees on utility space can be allowed to grow fully. Trees and bushes on farm bunds should be placed randomly at sufficient distance and pruned at repeated intervals. *Glyricidia* plants should be planted at close spacing on all major bunds and all around the farm. They will act not only as biological fence but also provide biologically fixed nitrogen to soil.

Sesbania

Calotropis

A 400 mt long Glyricidia strip can provide 22.5 kg N/ha per year from the year 3 and up to 77 Kg N/ha from year 7 under rainfed conditions. This can be 75-100% higher under irrigated

conditions. Three to four harvests can be made under irrigated conditions and two harvests under unirrigated conditions. Never allow them to grow above 5.5 ft to avoid shading effect. Lopping is used as green leaf manure. Simply harvest them and incorporate in soil before sowing or use as mulch.

Conversion of soil to organic

Banning of chemicals: It is widely known fact that some biological processes of plants involved in acquiring nutrients such as nitrogen e.g. N2 fixation are generally inhibited by adding Nitrogen fertilizer. Soil scientists generally caution against nonjudicious fertilizer use and encourage use of organic compost otherwise it may lead to deficiency of micronutrients. Therefore in organic farming systems there is no place for chemicals.

Low input alternative: In first year simultaneously sow three different types of legumes in strips, first of 60 days (like moong), second of 90-120 days (Cow pea or soybean) and third of more than 120 days (red gram) in strips. Apply mixture of Compost and vermicompost (2:1) @ 2.5 ton per acre enriched with 4 kg Azotobacter and 4 kg PSB biofertilizers or 4 kg consortia of customized cultures as basal dose at the time of sowing preferably in furrows below the seeds. Seeds of legumes should be treated with crop specific strains of Rhizobium biofertilizer. Mulch the entire surface with a thick layer of biological mulch and drench the biomass with Jivamrut @ 200 lit per acre. Seedlings will emerge from this layer. If soil is poor in phosphorus then apply 300 kg of low grade mineral rock-phosphate along with the compost. Apply second dose of Jivamrut after 25-30 days of sowing with irrigation water or during rains.

To add to diversity 100 plants/ acre of marigold or Hibiscus subdarifa or any other suitable plant effective as trap crop/plant may be planted randomly through out the field. Few seedlings of vegetables such as chillies, tomato, brinjal, etc and rhizomes of turmeric, ginger etc can be planted randomly for home consumption. Harvest the pods/ fruits and use remaining biomass for mulch. Collect the crop biomass at the end of strips in the form of heaps and drench with Jivamrut. Sow short duration leafy vegetables (such as fenugreek or spinach) in the space vacated by the first and second crop and mulch the surface with treated biomass. Harvest leafy vegetable and grains and incorporate remaining biomass in the soil at appropriate time. In next season apply compost-vermicompost mixture @ 2.5 ton/ha and sow cereal crop with legume as inter or companion crop. After harvest use entire legume and remaining part of cereal crop as mulch. If irrigation facilities are there, take summer legume with some vegetable crop. Recycle

entire residue as mulch. Use 3-4 application of liquid manure (such as Jivamruta) during each cropping season for soil application. Now the soil is ready for high value horticultural crops.

High input alternative: Incorporate 2.5-3.0 ton compost/ vermicompost or 1.5 ton of biodynamic compost, 500 kg crushed oil cakes, 500 kg rock phosphate, 100 kg neem cake, 5 kg Azotobacter and 5kg PSB biofertilizer or 4 kg consortia of customized cultures in soil through broadcasting or by drilling in furrows below the seeds. Sow 3-4 types of different crops in strips. 40% crop stand should be of legumes. Randomly plant 100-150 marigold and vegetable seedlings for increased diversity. After harvest incorporate entire residue in soil or use as mulch after sowing of the next crop. For second crop also use similar quantities of manures. Use liquid manure (Jivamruta) @ 200lit/acre 3-4 times during cropping season along with irrigation water. For increased productivity 2-3 sprays of vermiwash or vermiwash+cow urine or Panchgavya can also be provided. In fruit orchards cultivate 3-4 types of legume mixtures as mixed or intercrop in inter spaces along with adequate quantity of manures (as specified above). After pod/ grain harvest mulch the entire soil surface with the left over biomass and drench the biomass with 2 applications of Jivamruta. After about 12-18 months the soil will be ready for organic cultivation of any crop combination. For next two-three years, along with any crop incorporate legumes as inter or companion crops. Ensure that crop residue always have at least 30% residue from legumes. Also treat crop residue with liquid manure before incorporating into soil or using as mulch.

Multiple cropping and crop rotation

Mix cropping is the outstanding feature of organic farming in which variety of crops are grown simultaneously or at different time on the same land. In every season care should be taken to maintain legume cropping at least 40%. Mix cropping promotes photosynthesis and avoids the competition for nutrients because different plants draw their nutrients from different depth of soil. The legume fixes atmospheric nitrogen and make available for companion or succeeding crops.

Deep rooted plants drew nutrient from deeper layer of soil and bring them to the surface of soil through their leaf fall. So the nutrients leached down to lower strata are further brought back to upper layer by these deep rooted plants. Also help in protecting soil from soil erosion. Farmers should select the crops combination according to their needs and season. In selecting crop combinations, it is also to be kept in mind that plants also have their feelings, likes and

dislike e.g. maize gets along well with beans and cucumber, tomatoes go well with onions and marigold. On the other han beans and onions do not go well with each other. Entire farm should have at least 8-10 types of crops at all the times. Each field/ plot should have at least 2-4 types of crops out of which one should be legume. In case if only one crop is taken in one plot then adjacent plots should have different crops. For maintenance of diversity and pest control randomly plant 50-150/acre vegetable seedlings for home consumption and 100 plants/acre of marigold (Genda) in all crop fields. Even high nutrient demanding crops such as sugarcane can also be grown with suitable combination of various legume and vegetable crops with optimum productivity.

Crop rotation

Crop rotation is the back bone of organic farming practices. To keep the soil healthy and to allow the natural microbial systems working, crop rotation is must. Crop rotation is the succession of different crops cultivated on same land. Follow 3-4 years rotation plan. All high nutrient demanding crops should precede and follow legume dominated crop combination. Rotation of pest host and non pest host crops helps in controlling soil borne diseases and pest. It also helps in controlling weeds. It is better for improving productivity and fertility of soil. Crop rotations help in improving soil structure through different types of root system. Legumes should be used frequently in rotation with cereal and vegetable crops. Green manure crops should also find place in planning rotations. High nutrient demanding crops should always be followed by legume crops and returned back to soil. Some important benefits of crop rotations are:

a. Not all plants have same nutritive needs
b. Soil structure is improved through different types of roots
c. Pest build up is avoided and
d. Rotations help against the build up of weeds.

A fertile and live organic soil ideally should have organic C between 0.8-1.5%. At any point of time it should have adequate quantity of dry, semi decomposed and fully decomposed organic matter for the use of micro-flora and fauna. Total microbial load (bacteria, fungi and actinomycetes) should be above 1 x 108 /gm of soil. There should be at least 3-5 earth worms/cubic ft of soil. There should be enough quantity of small life forms and insects such as ants etc.

Seed/ Planting material Treatment

In organic management, protection measures are used only in the case of problematic situations. Use of disease free seed stock and resistant varieties is the best option. There is no standard formulation or treatment methodology, available as on today, but farmers use different methods. Few of such innovative seed treating formulations are as follows:

- Hot water treatment at 530C for 20-30 min.
- Cow urine or cow urine-termite mound soil paste
- Beejamrut
- Asphoetida 250gm in one lit. of water for 10 kg seed
- Turmeric rhizome powder mixed with cow urine
- Panchgavya extract
- Dashparni extract
- *Trichoderma viride* (4gm/kg seed) or *Pseudomonas fluorscens* (10gm/kg seed)
- Biofertilizers (Rhizobium/ Azotobacter +PSB)

Preparation of Beejamruta:

Put 5 kg fresh cow dung in a cloth bag and suspend in a container filled with water to extract the soluble ingredients of dung. Suspend 50 g lime in 1 lit water separately. After 12 – 16 hours squeeze the bag to collect extract and add 5 lit cow urine, 50 gm virgin forest soil, lime water and 20 lit water. Incubate for 8-12 hours. Filter the contents. The filtrate is used for seed treatment.

Manuring and soil enrichment

During conversion period, soil fertility can be improved and maintained initially through use of organic inputs like well decomposed organic manure/ vermicompost, green manure and biofertilizers in appropriate quantity. These organic inputs are used for feeding the soil. Well fed healthy soil rich in microflora and microfauna takes care of the crop nutrient requirement. Plant biomass, FYM, Cattle dung manure, enriched compost, biodynamic compost, Cow-pat-pit compost and vermicompost are key sources of on-farm inputs. Among off-farm inputs, important components are non-edible oil cakes, poultry manure, biofertilizers, mineral grade rock phosphate and lime etc.

Lopping from Glyricidia and other plants grown on bunds, on-farm produced compost and vermicompost, animal dung and urine and crop residue should form the major source of nutrient and concentrated manures such as crushed oil cakes, poultry manure, vegetable market waste compost and other novel preparations such as biodynamic formulations etc can be used in appropriate quantity. Use of high quantities of manures should be avoided. Changing crop rotations and multiple crops ensure better utilization of resources. Depending upon the type of crop and requirement of nutrients for different crops, the quantity of externally produced inputs is determined.

Application of liquid manure (for soil enrichment) is essential to maintain the activity of microorganisms and other life forms in the soil. 3-4 applications of liquid manure is essential for all types of crops. Vermiwash, compost tea, cow urine, Pachgavya and Biosol etc are excellent growth promoters when used as foliar spray. 3-5 sprays after 25-30 days of sowing ensure good productivity. Use of Biodynamic preparations, such as BD-500 and BD-501 as foliar spray has also been found to be effective in growth promotion.

Use of Biofertilizers and microbial cultures

Biofertilizers viz: Rhizobium, Azotobacter, Azospirillum, PSB, Zinc Solubilzing Bacteria (ZSB), Potash Mobilising Bacteria (KMB) and Pseudomonas etc have been found to be very effective tools of fertility management and biological nutrient mobilization. Recently customized consortia of such biofertilizer organisms, better adapted to local climatic conditions have also been developed and are available commercially. Efficiency of such microbial formulations is much higher under nochemical use situations, therefore application of such inputs need to be ensured under all cropping situations.

Method of application:

Biofertilizers can be applied to different crops and plants by three different ways.

1. **Seed treatment:** Suspend 200 gm each of nitrogen fixing and PSB in 300-400 ml of water and mix thoroughly. Pour this slurry on 10 to 12 kg of seed and mix by hands, till all the seeds are uniformly coated. Dry the treated seeds in shade and sow immediately. For acidic and alkaline soils it is always advisable to use 1 kg of slacked lime or gypsum powder respectively for coating the wet biofertilizer treated seeds.

2. **Seedling root dip treatment:** Suspend 1 to 2 kg each of nitrogen fixing (*Azotobacter*/*Azospirillum*) and PSB into just sufficient quantity of water (5-10 lit depending upon the quantity of seedlings required to be planted in one acre). Dip the roots of seedlings in this suspension for 20-30 min before transplanting. In case of paddy make a sufficient size bed (2mt x 1.5mt x 0.15mt) in the field, fill it with 5 cm of water and suspend 2 kg each of *Azospirillum* and PSB and mix thoroughly. Now dip the roots of seedlings in this bed for 8-12 hours (overnight) and then transplant.

3. **Soil treatment:** For soil treatment depending upon the total number of plants per acre 2-4 kg of *Azotobacter*/*Azospirillum* and 2-4 kg of PSB are required for one acre. Mix two types of biofertilizer in 2-4 liters of water separately and sprinkle this suspension on two separate heaps of 50-100 kg of compost. Mix the two heaps separately and leave for incubation overnight. After 12 hours, mix the two heaps together. For acidic soils mix 25 kg lime with this mixture. In plantation crops apply this mixture at the root zones by dibbling. In some field crops the mixture is broadcast evenly in the moist field and mixed with soil just before sowing. In sugarcane the biofertilizer manure is to be applied in furrows near the root zone, after 30-40 days of planting and covered with soil. In potato it is to be applied after 20 days of planting or at the time of earthing-up operations. In case of sugarcane and potato, if setts/tubers are not treated with plant protection chemicals then biofertilizer compost mixture can be applied in furrows immediately before planting.

Some important formulations for soil enrichment

Preparation of liquid manures

Many variants of liquid manures are being used by farmers of different states. Few important and widely used formulations are given below:

Sanjivak – Mix 100 kg cow dung, 100 lit cow urine and 500 gm jaggary in 300 lit of water in a 500-lit closed drum. Ferment for 10 days. Dilute with 20 times water and sprinkle in one acre either as soil spray or along with irrigation water.

Jivamrut – Mix cow dung 10 kg, cow urine 10 lit, Jaggary 2 kg, any pulse grain flour 2 kg and Live forest soil 1 kg in 200 lit water. Ferment for 5 to 7 days. Stir the solution regularly three times a day. Use in one acre with irrigation water.

Amritpani - Mix 10 kg cow dung with 500 gm honey and mix thoroughly to form a creamy paste. Add 250 gm of cow desi ghee and mix at high speed. Dilute with 200 lit water. Sprinkle this suspension in one acre over soil or with irrigation water. After 30 days apply second dose in between the row of plants or through irrigation water.

Panchgavya – Mix fresh cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow butter oil 1 kg and ferment for 7 days with twice stirring per day. Dilute 3 lit of Panchgavya in 100 lit water and spray over soil. 20 lit panchgavya is needed per acre for soil application along with irrigation water. Enriched Panchgavya (or Dashagavya) – Ingredients - cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow deshi ghee 1 kg, sugarcane juice 3 lit, tender coconut water 3 lit, banana paste of 12 fruits and toddy or grape juice 2 lit. Mix cow dung and ghee in a container and ferment for 3 days with intermittent stirring. Add rest of the ingredients on the fourth day and ferment for 15 days with stirring twice daily. The formulation will be ready in 18 days. Sugarcane juice can be replaced wit 500 g jaggery in 3 lits water. In case of non-availability of toddy or grape juice 100g yeast powder mixed with 100 g jaggery and 2 lit of warm water can also be used. For foliar spray 3-4 lit panchgavya is diluted with 100lit water. For soil application 50 lit panchagavya is sufficient for one ha. It can also be used for seed treatment.

Management of Temperature

Temperature in summer season is quite high and need to be managed. It can be achieved by keeping soil covered with biological mulch. Surface mulch has been reported to conserve soil moisture and improve water use efficiency (Hajare et al 1997). In the long term experiment at ICRISAT, it has been reported that mulch applied in this manner on the hottest day of summer (April 30) in 2002 the soil temperature at 5 and 10 cm depth in the mulch applied plots was 6.5 to 7.3^{o}C lower than in control plot (Rupela et al 2005). Temperature control can also be achieved by planting different types of trees like neem, amla, tamarind, gular, zizipus bushes, gliricidia on bunds.

Protection to all life forms

Practice of maintaining enough biomass and mulching with crop and weed residue will ensure the protection to all life forms in soil. Another important practice of banning the chemical fertilizers and pesticides in farming definitely helps in protecting the life forms in soil. For the survivability of different life forms the field must have dry organic matter as a food for small insects and small animals in soil, semi decomposed organic matter as food for earthworms and fully decomposed organic matter for micro organisms in the soil at all times. These insects, small animals ,earthworms and microorganisms are the tireless natural employees of the soil, wherein small animals and insects feed on the larvae of pests and thus controlling the pest, earthworms makes the soil porous thus creating the more aerobic conditions in soil and also decompose the half digested organic residue and release locked nutrients into soil. Soil rich in organic carbon contain ample quantity of beneficial micro flora which plays an important role in recycling of nutrients and nitrogen fixation, phosphate solubilization and photosynthesis activity, cellulolytic activity. Therefore protection to all life forms in soil should be ensured at all time.

Pest management

As in organic farming management use of synthetic chemicals are prohibited, the pest management is done by: (i) cultural or agronomic (ii) mechanical (iii) biological or by (iv) organically acceptable botanical extract or some chemicals such as copper sulphate and soft soap etc.

Cultural alternative - Use of disease free seed or stock and resistant varieties are best preventive practice in organic pest management. Maintenance of biodiversity, effective crop rotation, multiple cropping, habitat manipulation and use of trap crops are also effective practices which can keep the population of pests below economical threshold limit (ETL).

Mechanical alternative - Removal of affected plants and plant parts, collection & destruction of egg masses and larvae, installation of bird perches, light traps, sticky colored plates and pheromone traps are most effective mechanical methods of pest control.

Use of Biopesticides - *Trichoderma viride* or *T. harazianum* or *Pseudomonas fluorescence* formulation @ 4gm/kg seed either alone or in combination, manage most of the seed borne & soil borne diseases. There are other formulations viz. *Beauvaria bassiana*, *Metarizium anisopliae*, *Numeria rileyi*, *Verticillium* sp, which are available in the market and can manage

their specific host pest. *Bacillus thurengensis stenebrionis and B.thurengensis sandigo* are effective against coleopterans as well as some other insect species. Bt. has been used in the management of diamond back moth on crucifers and vegetables @ 0.5-1.0 kg. formulation per ha. Viral biopesticides of baculovirus group viz. granulosis viruses (GV) and nuclear polyhedrosis viruses provided a great scope in plant protection field. Spray of nuclear polyhedrosis viruses (NPV) of *Helicoverpa armigera* (H) or *Spodoptera litura* (S) @ 250 larval equivalents are very effective tools to manage the *Helicoverpa* sp. or *Spodoptera* sp. respectively.

Botanical pesticides - Many plants are known to have pesticidal properties and the extract of such plants or its refined forms can be used in the management of pests. Among various plants identified for the purpose, neem has been found to be most effective. Neem (*Azadirachta indica*) – Neem has been found to be effective in the management of approximately 200 insects, pests and nematodes. Neem is very effective against grasshoppers, leaf hoppers, plant hoppers, aphids, jassids, and moth caterpillars. Neem extracts, are also very effective against beetle larvae, butterfly, moth and caterpillars such as Mexican bean beetle, Colorado potato beetle and diamondback moth. Neem is very effective against grasshoppers, leaf minor and leaf hoppers such as variegated grasshoppers, green rice leaf hopper and cotton jassids. Neem is fairly good in managing beetles, aphids and white flies, mealy bug, scale insects, adult bugs, fruit maggots and spider mites.

Some other pest control formulations

Many organic farmers and NGOs have developed large number of innovative formulations which are effectively used for control of various pests. Although none of these formulations have been subjected to scientific validation but their wide acceptance by farmers speak of their usefulness. Farmers can try these formulations, as they can be prepared on their own farm without the need of any purchases. Some of the popular formulations are listed below:

Cow urine – Cow urine diluted with water in ratio of 1: 20 and used as foliar spray is not only effective in the management of pathogens & insects, but also acts as effective growth promoter for the crop.

Fermented curd water – In some parts of central India fermented curd water (butter milk or *Chaach*) is also being used for the management of white fly, jassids aphids etc.

Dashparni extract – Crush neem leaves 5 kg, Vitex negundo leaves 2 kg, Aristolochia leaves 2 kg, papaya (Carica Papaya) 2 kg, Tinospora cordifolia leaves 2 kg, Annona squamosa (Custard apple) leaves 2 kg, Pongamia pinnata (Karanja) leaves 2 kg, Ricinus communis (Castor) leaves 2 kg, Nerium indicum 2 kg, Calotropis procera leaves 2 kg, Green chilly paste 2 kg, Garlic paste 250 gm, Cow dung 3 kg and Cow Urine 5 lit in 200 lit water ferment for one month. Shake regularly three times a day. Extract after crushing and filtering. The extract can be stored up to 6 months and is sufficient for one acre.

Neem-Cow urine extract - Crush 5 kg neem leaves in water, add 5lit cow urine and 2 kg cow dung, ferment for 24 hrs with intermittent stirring, filter squeeze the extract and dilute to 100 lit, use as foliar spray over one acre. Useful against sucking pests and mealy bugs.

Mixed leaves extract - Crush 3 kg neem leaves in 10 lit cow urine. Crush 2 kg custard apple leaf, 2 kg papaya leaf, 2kg pomegranate leaves, 2 kg guava leaves in water. Mix the two and boil 5 times at some interval till it becomes half. Keep for 24 hrs, then filter squeeze the extract. This can be stored in bottles for 6 months. Dilute 2-2.5 lit of this extract to 100 lit for 1 acre. Useful against sucking pests, pod/fruit borers.

Chilli-garlic extract - Crush 1 kg Ipomea (besharam) leaves, 500 gm hot chilli, 500 gm garlic and 5 kg neem leaves in 10 lit cow urine. Boil the suspension 5 times till it becomes half. Filter squeeze the extract. Store in glass or plastic bottles. 2-3 lit extract diluted to 100 lit is used for one acre. Useful against leaf roller, stem/fruit/pod borer.

Broad spectrum formulation – 1: In a copper container mix 3 kg fresh crushed neem leaves and 1 kg neem seed kernel powder with 10 lit of cow urine. Seal the container and allow the suspension to ferment for 10 days. After 10 days boil the suspension, till the volume is reduced to half. Ground 500 gm green chillies in 1 lit of water and keep overnight. In another container crush 250gm of garlic in water and keep overnight. Next day mix the boiled extract, chilli extract and garlic extract. Mix thoroughly and filter. This is a broad spectrum pesticide and can be used on all crops against wide variety of insects. Use 250 ml of this concentrate in 15 lit of water for spray.

Broad spectrum formulation – 2: Suspend 5 kg neem seed kernel powder, 1kg Karanj seed powder, 5 kg chopped leaves of besharam (*Ipomea* sp.) and 5kg chopped neem leaves in a 20lit drum. Add 10-12 lit of cow urine and fill the drum with water to make 150 lit. Seal the drum and allow it to ferment for 8-10 days. After 8 days mix the contents and distil in a distiller. Distillate will act as a good pesticide and growth promoter. Distillate obtained from 150lit liquid will be sufficient for one acre. Dilute in appropriate proportion and use as foliar spray. Distillate can be kept for few months without any loss in characteristics.

Organic certification

It is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants. Requirements vary from country to country, and generally involve a set of production standards for growing, storage, processing, packaging and shipping that include:

- Avoidance of synthetic chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc) and genetically modified organisms.
- Use of farmland that has been free from chemicals for a number of years (often, three or more).
- Keeping detailed written production and sales records (audit trail).
- Maintaining strict physical separation of organic products from non-certified
- products.
- Undergoing periodic on-site inspections.

Purpose of certification

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and prevent fraud. For organic producers, certification identifies suppliers of products approved for use in certified operations. For consumers, "certified organic" serves as a product assurance, similar to "low fat", "100% whole wheat", or "no artificial preservatives". Certification is essentially aimed at regulating and facilitating the sale of organic products to consumers. Individual certification bodies have their own service marks, which can

act as branding to consumers. Most certification bodies operate organic standards that meet the National government's minimum requirements.

The certification process

In order to certify a farm, the farmer is typically required to engage in a number of new activities, in addition to normal farming operations:

- Study the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale.

- Compliance - farm facilities and production methods must comply with the standards, which may involve modifying facilities, sourcing and changing suppliers, etc.

- Documentation - extensive paperwork is required, detailed farm history and current set-up, and usually including results of soil and water tests.

- Planning - a written annual production plan must be submitted, detailing everything from seed to sale: seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations, etc.

- Inspection - annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview.

- Fee - A fee is to be paid by the grower to the certification body for annual survellence and for facilitatining a mark which is acceptable in the market as symbol of quality.

- Record-keeping - written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time. In addition, short-notice or surprise inspections can be made, and specific tests (e.g. soil, water, plant tissue analysis) may be requested.

For first-time farm certification, the soil must meet basic requirements of being free from use of prohibited substances (synthetic chemicals, etc) for a number of years. A conventional farm must adhere to organic standards for this period, often, three years. This is known as being in

transition. Transitional crops are not considered fully organic. A farm already growing without chemicals may be certified without this delay.

Importance of Biofertilizers

1. Biological wastes as sources of Biofertilizers

Significance of Waste Recycling, Chemical Characteristics of Wastes and Utilisation, Hydraulic loading is calculated as follows:, Heavy Metals and Associated Problems, Pathogens and Health Hazards, Effect on Crops Yield and Soil Properties, Effect on Crop Yields, NPK Through Fertilizer, Effect on Soil Properties, Problems in Waste Utilization, Future Research Needs

2. A note of Biofertilizerrs

Rhizobium, Production of Rhizobium Inoculants, Isolation of Rhizobium, Identification of Rhizobium, Establishing the Starter Culture, Mass culture of Rhizobium, Making the Carrier-based Inoculant, Packing and Storage, Field Application of Rhizobium Inoculant, Crop Respons, Azotobacter, Production of Azotobacter Inoculant, Field Applications, Seed Treatment, Seedling Treatment, Pouring of Slurry, Top Dressing, Beneficial Roles of Azotobacter, Azospirillum, Production of Azospirillum Inoculant, Isolation of Azospirillum, Confirmation of Azospirillum, Making the Starter Culture, Mass Culture, Carrier-Based Inoculant, Field Use of Azospirillum, Seed Treatment, Seedling Treatment, Top Dressing, Crop Response, Blue - Green Algae (BGA) Biofertilizer, Production of BGA Inoculant, Isolation of BGA, Starter Culture, Mass Culture of BGA, Storage, Field Use of BGA Inoculants, Crop Response, Phosphate Biofertilizers, Isolation of Phosphate Solubilizers, Mass Production, Field Application, Vesicular - Arbuscular Mycorrhizal Fungi, Genera of VAM Fungi, Morphology of VAM, Isolation of VAM spores, Mass Production of VAM, Field Application, Important of VAM Fungi, Azolla: A Green Manure Cum Biofertilizer, Mass Cultivation of Azolla, Field Application of Azolla, Azolla As A Green Manure, Azolla As A Dual Crop.

3. Role of Biofertilizer in Crop Production

Nitrogen-fixing Bacterial Inoculants, Rhizobium, Classification, Need for Inoculation, Competitiveness and Effectiveness of Strains, Factors Affecting Performance of Inoculant Strains, Yield Response to Inoculation, Azotobacter and Azospirillum, Yield Responses to Inoculation, Effect of Soil Nutrients, Frequency of Inoculation, Phosphate Solubilizing

Microorganisms, Mechanism of Action, Yield Responses to Inoculation, Vesicular-Arbuscular Mycorrhizae (VAM), Mechanism of Action, Root Colonisation, Yield Responses to Inoculation, Preparation of Inoculum, Plant Growth Promoting Rhizobacteria, Mode of Action, Yield Response to Inoculation, Future Research Needs, Strategy for Successful Use of Biofertilizers

4. Biofertilizers for Rice Ecosystem

Azolla, Growth and N-fixation, Factors Affecting Growth and N-fixation, Water, Mineral Nutrients, Light, pH and Salinity, Management Practices, Rate and Time of Inoculation, Fertilizer Application, Method of Rice Planting, Insects, Diseases and Weeds, Method of Utilization, Impact on Rice Yield and Soil Fertility, Availability of Azolla-N to Rice, Effects on Rice Yield and Soil Fertility, Economic Aspects, Suitable Agroclimatic Conditions, Adoption Constraints and Future Research Needs, Blue-Green Algae (BGA), Nitrogen Fixing Potential and N-input, Factors Affecting Growth and N-fixation, Management Practices, Fertilizer Application, Method of Rice Planting, Insects, Diseases and Weeds, Method of Inoculum Production, Method of Utilization, Impact on Rice Yield and Soil Fertility, Availability of BGA-N to Rice, Effect on Rice Yield, Economic Aspects, Suitable Agroclimatic Conditions, Adoption Constraints and Future Research Needs, Conclusions

5. Green Manuring

Green Manures, Leguminous Green Manures, Non-grain Legumes, Grain Legumes, Perennial Trees and Shrubs, Role of Green Manuring in Cropping Systems, Rice-based Systems, Sugurcane-based System, Cotton-based Systems, Potato-based Systems, Rainfed/dryland Systems, Plantation Crops, Fate of Green Manures on Application to Soils, Availability of Essential Nutrients, Crop Responses and Residual Effects, Green Manure Management, Residual and Long-term Effects, Maize yield (t/ha) Corresponding N input, Economics of Green Manuring, Constraints of Green Manuring, Future Research Needs, Conclusions

6. Production and Distribution of Biofertilizers

Definition and Classification, Practical Significance of Biofertilizers, Requirement of Biofertilizers, Production Technology of Biofertilizers, Rhizobium, Sources of Mother Cultures, Carriers, Production of Biofertilizers, Rhizobium, Azospirillum & Azotobacter, Blue Green Algae, Standards and Quality Control, Government Support and Programmes, Constraints, Production and Distribution Level Constraints, Storage and Distribution, Constraints at Field Level, Market

Level Constraints, Areas for Future Development, Training, Improvement in production technology, Need for preparation of biofertilizer map, Region-specific effective strains, Necessary quality control acts, Proper storage facilities, Conclusions

7. Biological Nitrogen Fixation

Non-symbiotic Nitrogen Fixation, Features Favourable for Non-symbiotic Nitrogen Fixation, Special Separation of Nitrogen Fixing Cells, Protein-Nitrogenase Association, High Rate of Respiration, Time Specific Nitrogenase Activity, Association With Rapid Oxygen Consumers, Presence of Hydrogenase, Colonizarion, Nitrogenase, Basic Requirements For Nitrogen Fixation, Mechanism of Nitrogen Reduction, Assimilation of Ammonia, Symbiotic Nitrogen Fixation, Root Nodulation, Mechanism of Nitrogen Fixation, Nitrogenase, Requirements For Nitrogen Reduction, Assimilation of Ammonia, Genetics of Nitrogen Fixation, Nif-genes of Klebsiella Pneumoniae, Regulation of Nif Genes, Nif-genes of Azotobacter, Nif-genes of Anabaena, Rhizobial Genes, Legume Nodulin Genes, Overall Regulation of Genes, Gene Transfer for Nitrogen Fixation, Transfer of Nif genes to Non-nitrogen Fixing Bacteria, Transfer of Nif genes to Plants, Transfer of Nif-genes fo Pfanfs, Transfer of Nod Genes, Transfer of Hup Genes

8. The Source of Organic Matter

The Root-system of Crops Soil Algae, Green-manures, Farmyard Manure, Artificial Farmyard Manure

9. The Chief Factors in Indore Process

The Continuous Supply of Mixed Vegetable Wastes, Composting Single Materials, Nitrogen Requirements, The Amount of Water Needed, The Supply of Air, The Maintenance of the General Reaction, The Fermentation Processes, Gains and Losses of Nitrogen, The Character of the Final Product.

10. Manufacture of Biofertilizer by the Indore Method

The Compost Factory, Collection And Storage of the Raw Material, Plant Residues, Urine Earth and Wood Ashes, Water and Air, ARrangement and Disposal of the Bedding under the Work Cattle, Charging the Compost Pits, Turning the Compost, Time-table of Operations, Output, Manurial Value of Indore Compost.

11. Organic Matter and Soil Fertility

Soil Humus, its Origin and Nature, The Formation of Humus as a Result of the Synthesizing Activities of Micro-organisms, The Role of Humus in the Soil, The Washington Symposium on Soil Organic Matter.

12. Weed Management in Organic Farming

Cultural Methods of Weed Control, Tillage, Tillage combined with irrigation, Timing, Seeding rates and cultivar selection, Cropping systems, Use of animals, Flooding, Mulching, Fire, Composting, Hoeing and hand weeding, Farmer's care, Straw disposal, Biological Control of Weeds Using Insects, Weed suitability tobiological control, Classical approach, Characteristics of weeds and problems, Weed survey for Natural enemies, Introduction of natural enemies, Use of Pathogens in Weed Suppression, Mycoherbicides, Characteristics of good Mvcoherbicide, Use of seed-borne and seed infecting microorganisms, Parasitic Weeds, Management strategies for parasitic weeds, Biological control, Ecological Principles, Research Needs.

13. Pest Management in Organic Farming

Pest Management Methods, Biological alternatives, Organically acceptable chemical alternatives, Cultural alternatives, Biological Control, Advantages of Bio-control:, Botanical pesticides, Bacterial insecticides, Viral insecticides, Microbial antibiotics, Biological control in field crops, Other Crops, Botanics for Storage Pest Control, Seed treatment with materials of plant origin for insect control, Active principles, Cultural Practices/Ecological Methods, Optimum site conditions, Diversity over Time, Rotations, Diversity in space, Habitant enhancement, Role of Non-crop vegetation, Trap crops, Constructed traps, Plant resistance to pests, Traditional Practices for Pest Control, Other Management Practices.

14. Rice-Fish Integration of Organic Farming

Externalities of Green Revolution, Rice Productivity in States of India, Lowland Rice Ecologies, Diversification- IPS Approaches, A fish harvest from rice field, Vanishing rice lands - Economic sustainability issues, Pokkali system-the classic example, Rice-Fish, Harnessing complementarities, Group Fish Farming (GFF), Environmental Superiority, Economic sustainability, Win-Win Land use Model.

15. Choice of Varieties for Organic Farming

What is organic Agriculture? Selection of rice varieties for organic farming, Weed Control, Soil fertility, Insects and Diseases, Speciality rices for organic farming, Varieties for Special systems of cultivation, Pokkali, Koottumundakan cultivation.

16. Coastal Agro-Eco System in Organic Rice Farming

Organic farming - the truths vs. myths, Organic food tastes better and is of superior quality, Organic food is more nutritious and safer, Organic farming is eco-friendly, Organics as a source of Plant nutrients, Organic Farming and Food Security, Organic Farming- a lesson from China, Biodynamic Farming, System Of Rice Intensification (SRI).

17. Microorganism for Organic Farming

Biological nitrogen fixers, Legume - Rhizobium symbiosis, Azospirillum, Different methods of application of Azospirillum in the field, Cyanobacteria (Blue green algae - BGA), Mass Production of BGA in the field, Anabaena - Azolla Symbiosis, Utilisation of Azolla for rice, Mass production of Azolla in the field, Phosphorus solubilising microorganisms, Arbuscular Mucorrhizal Fungi (AMF), Silicate solubilising bacteria, Zinc solubilising bacteria, Plant Growth Promoting Rhizobacteria (PGPR), Efficacy of PGPR in rice, Methods of application of Pseudomonas fluorescens in rice, Seedling root dip, Soil application, Foliar spray, Microbial consortium for rice

Vegetable Production in Home Gardens

According to the World Health Organization (WHO), a matured person should consume daily 400 grams of vegetable (excluding potato) to live a healthy life. Similarly, the Government of Nepal suggests a daily intake of 375 grams of vegetables (excluding potato). However, insufficient access to market and seasonal fluctuation of available vegetable makes it difficult to intake sufficient amount of vegetable for rural households. Thus, a home garden in rural Nepal is very essential where people can regularly grow vegetables in small piece of land. However, it is also commonly seen that many rural households do not apply appropriate cultivation techniques, which result in limited production, and frequent occurrences of pest and diseases attacks. As a result, it is compellation to enjoy with limited production of vegetables. Hence, by utilizing effective techniques in home gardens with good seed and appropriate vegetable cultivation technologies, vegetable production can be significantly increased. This will enable

the rural households to secure more vegetable for their consumption. At last, it will further contribute to the healthy lives of the rural population.

Concept of vegetable production in home gardens

The objective of vegetable production in home garden is to produce vegetable to support daily intake for the family members throughout the year. In regards to this point, home garden shall not aim only at increasing the amount of vegetable for a single production, but also aim at constant and sustainable production throughout the year. For this reason, the following concepts should be applied.

Use of perennial vegetables

Perennial vegetables like: chili (*Akabare Khorsani)*, dundu (Chhepi type leafy green vegetable), squash, tree tomato, Kangkong, wild spinach*, (Jibre saag),* turmeric, ginger, Chayote (lettuce), Lamb's quarter (*Bethe*), etc., can be cultivated in the home garden.

Use of legume crops

Legume crops, such as cow pea and beans, are not only source of rich in protein but also easy to grow. It also helps to maintain the soil fertile. Therefore, legume crops should be frequently included in the production of vegetable in home gardens.

Use of local material, means and technology

Local resources, means and technology should be utilized to the maximum extent, in order to minimize the work and maximize the production of vegetable.

Use of compost made from local material

- Well ripened compost manure should be used more in kitchen garden rather than chemical fertilizers.
- Crop residue of vegetables and other weeds in garden after harvest can be used for preparing compost.

Use of mulch to maximize the use of water

Waste water from kitchen and bathroom (after washing vegetables, utensils and clothes or taking bath) can be used to irrigate the kitchen garden during dry season. As securing of water for irrigation is often a problem faced in the home gardens in the mid-hill areas, mulching

has to be followed. By covering (mulching) the soil surface with locally available material, it can be effectively utilized in the vegetable farm.

Material that can be used for mulching: straw, dry leaves, *ashuro, titepati,* etc.

Benefit of mulching

- It maintains the soil moisture
- It holds soil during irrigation and rains
- It helps preventing weeds.
- Mulching materials later on can be used as manure.

Nursery Bed in Home Garden

Definition of nursery

A vegetable nursery is a place for raising young vegetable seedlings until they are ready for transplanting.

Advantages of nursery bed

- Various advantages of nursery in vegetable production.
- Convenient to look after the large number of seedlings in small area.
- Cost effectiveness in land management.
    - Easy in management of pest, disease and weed control and irrigation.
    - Possible to provide favorable growth conditions i.e. germination as well as growth
    - Improved crop uniformity.
    - Easy to produce strong and healthy seedling, saplings
    - Maximum germination rate, and thus cost effectiveness
    - Nursery can be prepared in unfavorable season.

3.1.2 Factors to be considered for raising a nursery

Location of the nursery should be:

- Land close to the house
- Well exposed to the sun, but protected against severe heat
- Well protected against animal damage and strong winds

Vegetable crops can be grown in two ways; either by sowing seed straight in the field, or by preparing seedlings in seedbeds and transplanting the seedlings in the permanent area. In general, the vegetables that are grown directly sowing seeds are - *chamsur*, spinach, beans, cow pea, radish, turnip, peas, pumpkin, sponge squash, etc.; whereas, the vegetables that are grown preparing seedlings are - cauliflower, cabbage, broccoli, broad leaf mustard, swish chard, *Jiriko saag*, onion, asparagus, tomato, brinjal, chilly etc. In addition to, the small seedlings of the cauliflower species should be re-transplanted to another bed in distance, which is known as hardening of seedlings.

Establishment of seedbeds in nursery garden

Methods of Cultivation of Vegetables

Specific Methods for Pumpkin Cultivation

- Pumpkins are popular vegetable crop cultivated during summer-rainy season.
- The pumpkin is popular due to high yielding and holding good storage capacity.
- The tip of the vine 40 – 50 cm (young shoots) can be used as green vegetable.
- Apart from young tendrils, fruits are also used as green vegetable. And, ripe fruits can also be used as vegetable curry.

Health Benefits

A ripe-yellow pumpkin is rich in Vitamin A, and it has many medicinal values.

Pumpkin Cultivation

Planting distance

The distance between the seeds sown or transplanted plant should be 1.5 to 2 meters apart in sunken bed or sunken pit.

Harvesting

- Generally, the first fruit is ready to harvest after 110 – 120 days from seed germination.
- We can harvest young side shoots as green vegetable, green fruit and ripe fruit.

Specific Methods for Sponge gourd Cultivation

- Cultivation of sponge gourd plant thrives best in warm and humid climatic condition. But, there is comparatively less female flowering in this condition
- Sowing under low temperature, warm and humid (like in months of February, March) climatic condition, there is flowering of more female flower, which results to more production.
- Generally, sponge gourd is cultivated in April May. In high temperature and high humid season (June, July), there is flowering of more male flower only, which results to less production.
- September October is suitable for harvesting sponge gourd.

Health benefits

Sponge gourd contains various antioxidants, minerals, vitamins, nutrients and lipids. It is an excellent source of Vitamin “A”, Vitamin “B”- 5, Potassium, manganese, potassium, etc.

Sponge gourd cultivation

Planting distance

The distance between the seeds sown or transplanted plant should be 1.5 to 2 meters apart in prepared land. While sowing or transplanting sponge gourd, the soil should be raised a little bit.

Harvesting

Sponge gourd fruit grows to a smoothly cylindrical and about 60 cm in length and 8 cm in diameter. In general, the fruits should be harvested at young stage with thinner skin and green. Normally, fruits are best to be consumed when it is small (less than 12 cm in length) and still green. The fruits will be ready to harvest 20-25 days after the flowering. It is best to harvest before the fruit grows sponge inside.

Specific methods for bitter gourd cultivation

- Like in other members of the cucurbits family, it is also a fast-growing, trailing or climbing vine with thin stems and tendrils. Thus, it requires a trellis to support their climbing vines.
- Bitter gourd is characterized by soft lengthwise ridges and uneven pebbly surface. Depending upon the variety type, its immature fruit is light to dark green, and have oblong or oval shapes with a pointed tip at the blossom end.
- Internally, the flesh is white with rough-edged seeds, somewhat similar to ridge gourd seeds in appearance. As the fruits begin to mature, they gradually become hard, turn yellow or brown in color.

Bitter gourd cultivation

Health benefits

- Bitter gourd notably contains insulin-like substances, Phyto nutrient, and polypeptide etc. mostly known to lower the blood sugar level.
- It has small amounts of B-complex vitamins such as niacin (vitamin B-3), pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6) and minerals such as iron, zinc, potassium, manganese and magnesium, which are essential for developing immunity power of body.

Planting distance

The distance between the seeds sown or transplanted plant should be 1.5 to 2 meters apart in prepared land. While sowing or transplanting sponge gourd, the soil should be raised a little bit.

Harvesting

- Generally, the first crop of bitter gourd is ready for harvesting after 50-60 days of seedling transplantation or 80-90 days after sowing.
- The young fruits of bitter gourd will be ready to harvest in 2-3 weeks after flowers setting in summer; while in 4-5 weeks in autumn season.
- The fruits can be harvested at the interval of 2-3 days.

Major diseases and pests, and their control in cucurbits

Generally, all types of vegetables in this cucurbits group are susceptible to similar types of diseases and pests; however the ratio of infection and infestation vary from crop to crop.

Major diseases: The main diseases of cucurbits family are powdery mildew, downy mildew, bacterial wilt, cucumber mosaic virus in farming.

Integrated Pest Management

Traditional practices to control pests

- The land and soil should be kept clean and removing diseased leaves or crop residues and weeds too.
- Application recommended nitrogen fertilizer (Urea).
- Cultivate the disease resistant varieties.
- Change location from year to year.

Natural practices to control pests

It can be controlled by sprinkling solution prepared mixing one part of cow's or buffalo's urine with 8-10 parts of water, 3-4 times at the interval of 4-5 days.

Cultivation of Tomato

Tomato occupies a prime position in list of protective foods since it is a rich source of minerals like calcium (48 mg / 100g), sodium (12.9 mg), trace elements, copper (0.19 mg), vitamins like vitamin A (900 IU), vitamin C (27 mg), vitamin B complex (thiamine), essential amino acids and healthy organic acids like citric, formic and acetic acids. The attractive red colour of fruit is due to lycopene and yellow colour is due to carotenes. Peculiar flavour of tomato is due to presence of ethanol, acetaldehyde and a number of volatile flavour components found in fruit. Different forms of tomatine, a steroidal glycoalkaloid, are identified from various parts of plant. Tomato is a good appetizer and its soup is a good remedy for preventing constipation.

Varieties

Quiet a large number of varieties differing in their climatic requirements, growth habit, fruit quality, resistance to pest and diseases are developed for specific purposes like fresh market, processing, long distance transport etc.

Tomato

Climate

Tomato is a day neutral warm season crop, which cannot tolerate frost. Cool and dry weather is preferred by the crop and optimum temperature is 21-28^{0}C during day and 15-20^{0}C during night. Night temperature is more critical than day temperature. High temperature results in exerted stigma, dryness of stigma, burning of anther tip, poor pollen dehiscence, low pollen viability and slow pollen tube growth leading to low pollination and fruit set. Incidence of viral diseases also will be more at high temperature. Optimum temperature for colour development of fruit is 21-24^{0}C. Development of colouring pigment, lycopene will be hampered above 270C Seed germination and pollen germination are adversely effected below 10 Based on night temperature requirement for fruit set, tomato varieties are classified into three.

- Normal set varieties: Set fruits at 15-20^{0}C.
- Hot set varieties: Set fruits above 20^{0}C
- Cold set varieties: Set fruits below 15^0 C

Tomato cannot withstand water logging. Hence well drained fairly fertile soil rich in organic matter is preferred. It is moderately tolerant to acid soil having pH 5.5 and ideal pH requirement is 6-7^{0}C.Sowing time and seed rate.Under mild climatic conditions, where there is no danger of frost, three crops can be raised in a year. In the hills, seeds are usually sown in March-April. In plains is grown during June to November. Under Kerala condition, seeds are sown in September and transplanted in October.

Manures and fertilizers

Manure and fertilizer recommendation for tomato depends on the growth habit and productivity of variety and it var ies from state to state. In most of states, in addition to 15-20 tonnes of FYM, N- 100-125 kg, P_2O_5-50-60 kg, and K_2O 50-60 kg are recommended for one hectare.FYM should be incorporated in soil at the time of final ploughing. 1/3 N, Full P and K may be applied as basal dose either just before transplanting or 5-10 days after transplanting. Remaining 2/3 N is applied 20 and 45 days thereafter. Additional dose of 10 kg borax and 5 kg Zinc Sulphate, as basal dose, are also recommended for correcting fruit cracking and to increase yield and fruit quality.

Irrigation

Furrow irrigation is the most common method in tomato and the crop require adequate moisture throughout growth period. Frequency of irrigation depends on the climatic and soil conditions. During summer, crop should be irrigated at 3-4 days interval. Water stress at flowering stage will adversely affect fruiting and productivity. A long spell of drought followed by heavy irrigation leads to cracking of fruits. Similarly a dry spell after regular irrigation causes blossom end rot. Drip irrigation and sprinkler irrigation are becoming more common in areas of water shortage.

Harvesting

Crop starts yielding by 70 days after planting. Usually fruits are harvested with hand by a gentle twist so that the stalk is retained on plant. Intervals of harvests depend on season and it is twice in a week dur ing summer and weekly during winter and rainy days. Harvesting maturity depends on the pur pose whether for fresh market, processing, long distance transport etc. Following maturity standards are recognized in tomato:

- Mature green: Fruits fully grown, fruit colour changes from green to yellowish and cavity filled with seeds surrounded by gelly like substance. Harvested for long distance market.
- Turning or breaker stage: Fruits firm, 1/4t portion of fruit changes to pink in colour, but the shoulder still yellowish green. Harvested for long distance market.
- Pink stage: 3/4t of whole fruit surface turns pink colour. Harvested for local market.
- Light red: Entire fruit surface is red or pink but the flesh is firm. Harvested for local market.
- Red ripe or hand ripe: Fully ripened and coloured. Flesh becomes soft. Harvested for processing and for seed extraction.

Grading storage and marketing

Fruits after harvesting are graded and packed in bamboo baskets or wooden boxes. Four grades specified by Bureau of Indian Standards are Super A, Super, Fancy and Commercial. Since tomato is a climatic fruit, good care should be taken to remove bruised, cracked and damaged fruits before packing in baskets. Though tomato can be stored at low temperature, commercially it is not stored in cold storages in the country due to practical reasons. Fruits can be stored for-two weeks and four weeks at 10-130 C when harvested at red stage and green stage respectively. Pre-cooling of fruits before storage and transportation enhances storage life.

Importance of Wild Vegetables

Although the current global food system is believed to be capable of providing enough calories for the world, there are still around two billion people who experience hunger or do not have access to a nutritious diet. An increasing number of countries experience the double burden of malnutrition, where under-nutrition coexists with overweight, obesity and other diet-related diseases. Recent years food systems are failing to deliver a healthy diet and are inequitable and environmentally unsustainable. Global trade and markets play an omnipresent role in influencing human dietary and lifestyle habits, and among Indigenous and vulnerable communities, tend to increase the consumption of highly processed foods of poor nutrient value. For these many reasons, traditional landscapes, cultures and food-ways are increasingly homogenized, and many communities are undergoing a nutritional transition negatively affecting their health. Wild vegetables have been part of diets and traditional food systems throughout human history, providing important nutrients and bioactive compounds. Ancestral and contemporary traditional diets are known to over valuable health benefits. There are also suggestions that humans and their genome are adapted to the diet and environment from past times and that contemporary diets and lifestyles are not optimal for the human genome.

The high consumption of ultra-processed foods, which also seems to push the human gut microbiome to produce negative health outcomes and inflammation. Wild food plants are traditional foods that tend to be richer in micronutrients than cultivated crops. This offers the potential for alleviating micronutrient deficiencies in some contexts such as among rural and Indigenous communities. Wild vegetables also represent bioactive functional foods that could contribute to healthy diets and immunity to a variety of illnesses. Among Indigenous

communities, a higher use of wild foods has been linked with greater food security. They are embedded in traditional food knowledge, which represents an integral part of local and sovereign food systems. Despite their potential benefits, this vegetable plants have been overlooked and excluded from most formal education, policies and research or development programs. The food and agriculture sectors have neglected wild species in favor of cash crops and starchy staples. The availability in nature has resulted in low economic valuation, which further reduces their visibility and promotion despite their nutritional, health, social and ecological benefits.

Wild Edible Plants

Wild plants have received great importance at different places and times of the human history given their ability to provide nutrients during scarcity periods and protection for minor health conditions. Their popularity comes from the need for nourishment in regions experiencing food shortages, where wild edible plants have played an important role in complementing staple agricultural foods and poverty alleviation, and from the perceived health-promoting effects and cultural trends.. Moreover, the long use of wild edible plant is associated with particular wisdom and practices, and above all great creativity pulsing with life, and with each user, household, region or country.

Medicinal Properties of Wild Leafy Vegetables

Most of wild edible vegetable species have medicinal property and can be used to keep people healthy and fit. Further phytochemical and neutraceutical studies of these edible species may provide better nutritional source. Apart from the source for food, human also utilize plants for dyes, ornaments and medicines. Wild edible plant are source for nutrition but also posses higher medicinal property. These wild plant are grown in forest region without Chemical / Fertilizer. Most of wild vegetable are grown naturally without proper cultivation technique in forest area; Specifically during monsoon season and collected by tribal people. Tribes are part of nature, they fulfill their need through wild resources. Their knowledge based upon traditional source. Consuming wild edible is food habits of people. Various reports also noted that many wild edibles are nutritionally rich and can supplement nutritional requirements, especially vitamins and micronutrient. Nutritional analysis of wild vegetable demonstrate that the nutritional quality of wild vegetable is comparable and in some cases they are superiors to domesticated verities. Many medicinal values of certain vegetables yet to be documented, so there so need of explore, analyze and document the wild vegetables which posses medicinal values.