

Sustainable Agricultural Practices



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Dr. Vanaja Ramprasad, H.S.Srikanthamurthy,
Ningappa Kakol, Shivakumar, B.Nagaraju,
Ningaraju, Shashidhara, Doddappa, A.R.Vijay,
M.Shivanna, N.Obanna, A.C.Pandu,
Rama Satish, Sandhya Madhu,
Veena Pacchapur, Suma Srinivas



Green Foundation
Bangalore

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Green Foundation
No. 30. ‘Soorya’, 4th Main, 19th Cross,
N.S. Palya, B.T.M. II Stage,
Bangalore - 560 076
Phone : 080 26784509, Fax : 080 26680995
Mobile : 9449861043
Email : green@greenfoundation.org.in
www.greenconserve.com

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PREFACE

:

A Handbook on “Sustainable Agricultural Practices” encompasses several agricultural practices that are being practiced by the farming community in different parts of the country. Ecological agriculture revolves around three important factors, namely soil, water and the seed. In nature, organic relationships are a pervasive phenomenon and everything is inter-connected. The integral relationship seen between soil, water, flora, soil microbes is obvious. It is the totality of these relationships that becomes the bedrock or organic and sustainable farming. Much of the understanding of this relationships is reflected in this Sustainable Agricultural Practices. Maintaining soil fertility and productivity on sustainable basis is of primary importance for continuous agriculture production Knowledge that has been in existence for over 2000 odd years has been undermined. Indigenous agricultural knowledge is a vital part of the process of making agriculture sustainable. The attempt here is to compile all the traditional practices for crop improvement, increment in growth and yield of a crop, pest and disease management, nutritional deficiency, soil and moisture conservation, animals in agriculture etc.

In this direction, GREEN Foundation has contributed in bringing the sustainable practices together to help the farmers, research scientists on organic farming, other NGO working in this direction as well institutions working in this field.



INDEX

PREFACE

I. AGRICULTURAL PRACTICES	1
1. Crop Improvement Technique	2
2. Crop Rotation	4
3. Companion Crops	5
4. Seed Production	6
5. Soil Testing	8
6. Seed Treatment before sowing	
a. Paddy seed treatment	10
b. Groundnut seed treatment	11
c. Ragi seed treatment	11
d. Millet and Sorghum Seed Treatment	12
e. Bio-fertilizer Seed Treatment	13
f. CPP manure seed treatment	14
g. Seed treatment with milk	14
7. Mulching	15
8. Kitchen Garden	16
9. Drip Irrigation	17
10. Seed Storage / Conservation Practices	18
a. Soil application	18
b. Mixing of leaves	19
c. Castor-chilli-salt treatment	19
d. Stepping method	19
e. Sand method	20
f. Storage in Moode	20
g. Storage in Cement granary (Kanaja)	21

II. ORGANIC MANURES

1. Farm Yard Manure	22
2. Low Cost Vermicompost	24
3. Enriched Vermicompost	26
4. Green Leaf Manure	27
5. Tank Silt	28
6. Organic Urea / Sand Urea	29

III. CROP / PLANT PROTECTION MEASURES

1. Poochimarandu	31
2. Effective Microorganism - Fermented Plant Extract (EM-FPE) Solution	33
3. Agricultural Formulations	35
4. Chilli-Garlic-Ginger Extract	41
5. Beejamrutha	42
6. Biofertilizers to control diseases as soil application	43
7. Panchagavya	44
8. Cow Urine	47
9. Sasyamrutha	48

IV. PLANT GROWTH PROMOTERS

1. Vermiwash	50
2. Jeevamrutha	52
3. Activated Effective Microorganism (AEM) Solution	53
4. Fish Oil	54
5. Amrithpani	55
6. Egg Lime (Muttai rasam)	56
7. Egg Amino Acid (EAA)	57

V. IMPROVED AGRICULTURAL PRACTICES

1. System of Rice Intensification (SRI)	58
2. System of Plant Intensification (SPI)	61
3. Guli Method in Ragi	62

VI. BIODYNAMIC FARMING PRACTICES

1. Biodynamic Calendar Sowing	66
2. Cow Horn Manure	71
3. Cow Pat Pit Manure	73
4. Cow Horn Silica	75

VII. LAND DEVELOPMENT ACTIVITIES

1. Agroforestry	77
2. Contour Sowing	79
3. Trench Cum Bunding	80
4. Bench Terracing	81
5. Farm Pond	82
6. Check Dams	84

VIII. ANIMAL FEED

1. Azolla	86
2. Silage	88
3. Hay	90
4. Banave – Fodder storage technique	92



Thanks To

The information in the book ‘Sustainable Agricultural Practices’ is collected from the following sources.

- * Organic farming skills development Guide-crop production and plant protection.
 - * ICAR sponsored winter school on “Jaivik Krishi in Fruit culture - 2006” -University of Agricultural sciences, Dharwad.
 - * Panchagavya - Mr. S. Natarajan and others, India press-Goa.
 - * Honeybee - A Magazine (procedures).
 - * Beejamrutha - Mr. Subash Palekar.
 - * Puchimarundu - Mr. Selvamuthu.
- * Community Seed Banks, Their Members and Members of the Rural Development Organisations

Green Foundation is grateful to above said sources and all the people involved in bringing out this book.

I. Agricultural Practices

FARMER FRIENDLY AGRO-ECOLOGICAL TECHNIQUES

Agro-ecosystems are communities of plants and animals interacting with their physical and chemical environments that have been modified by people to produce food, fiber, fuel and other products for human consumption and processing. Agro-ecology is a holistic study of agro-ecosystems, including all environmental and human elements. It focuses on the form, dynamics and functions of their interrelationships and the processes in which they are involved. Agro-ecology works on the principles that will have different effects on productivity, stability and resiliency within the farm system, depending on the local opportunities, resource constraints and, in most cases, on the market.

By assembling a functional biodiversity it is possible to initiate synergisms which subsidize agro-ecosystem processes by providing ecological services such as the activation of soil biology, the recycling of nutrients, the enhancements of beneficial arthropods and antagonists, and so on. Agro-ecology provides the knowledge and methodology necessary for developing an agriculture that is on the one hand environmentally sound and on the other hand highly productive, socially equitable and economically viable.

Some of the Agro-Ecological Practices are discussed below for the benefit of farmers.

CROP IMPROVEMENT TECHNIQUE

With the introduction of High Yielding Varieties (HYV) and hybrids after Green Revolution in India, numerous land races and local varieties have resulted in extinction. Some farmers are conserving local genetic diversity by selecting the seed for the next cropping season. This process modifies the genetic characteristics of the crop. This modification of genetic characteristics for the improvement of crop with involvement of farmers and breeders is referred as participatory plant breeding. Plant breeding involves two crop improvement programmes like (a) Participatory Varietal Selection (PVS) and (b) Purification

A) Participatory Varietal Selection :

1. Identifying farmer needs in cultivars - Identification of indigenous varieties of seeds with high grain and fodder yield, pest and disease resistance, flood and drought resistance, good aroma and taste, cooking quality, short duration crops and adaptability to local climatic conditions is an important task in Varietal Selection.

2. Searching out suitable material to test with farmers

3. Conducting experiments on its acceptability in farmer's field

4. Once it is accepted, wider dissemination of that farmer preferred cultivars

B) Seed Purification :

1. The seeds selected on participatory basis in the first generation is raised in three farmers' field for mass selection.



2. Experienced farmers are invited to purify the variety with characters like equal height of the variety, uniform earhead size, plant and flower characteristics, uniformity in grain shape and colour, uniform maturity, etc.

C) Crop Improvement :

1. The Ear heads purified in the previous year can be used for further development. Every year the identical ear heads have to be selected and purified. So, the plants having good sustainable characteristics can be used for cultivation in large areas. The earheads growing on the main, central stalk of the plant, is usually the healthiest and the grain from that portion is used as seed. The grain in the upper half of an earhead is selected as they are heavier and more filled. Top half of the earheads are cut-off and selected for the purpose of sowing in the next season.

2. Seeds purified by the farmers are raised for bulking in the second generation.

3. Seeds obtained during the second mass selection are grown in different regions to study the suitability of farmer-selected variety in five farmers field.

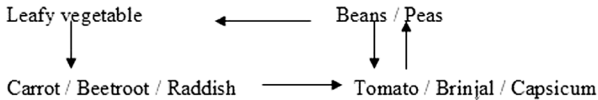
Farmers can expect a high yield of crops and grass if they select good quality ear heads every year and cultivate. The farmers can solve the problem of seeds from some other sources if they identify the quality seeds grown in their own fields simultaneously obtaining good crop yield. Farmers can become self sufficient and reduce the expenditure as well. Thus varietal improvement involving farmers is an ultimate method of crop improvement and maintenance of genetic diversity in the farmers field.

CROP ROTATION

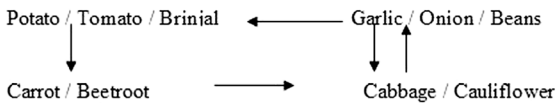
Growing different crops like monocotyledons followed by dicotyledons on a same piece of land is termed as Crop rotation. To stimulate the microbial population that are present in the root zone of plants (the rhizosphere), crop rotation is a very important technique that has to be followed by the farmers. Different species of plants are raised to reduce pest and disease attack, maintain the fertility status of soil and ultimately increase the yield. There are four fundamental reasons why crop rotation should be followed. Not all plants have the same nutritive needs. Soil structure is improved through the action of roots. Pest buildup is avoided. Helps against the buildup of weeds.

The adopted crop rotations patterns are mentioned below :

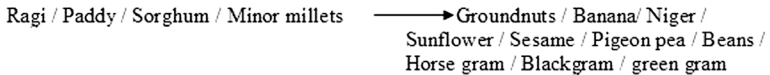
Pattern 1 :



Pattern 2 :



Pattern 3 :



COMPANION CROPS / MIXED CROPS

Companion crops / Mixed crops are the crops grown generally to avoid diseases & pest attacking the main crop. The companion crop attract the pests that attack the main crop inturn maintaining the quality and quantity of yield. of the help the high yield of healthy main crop. This helps in reducing the man power and extra costs incurred on pesticides or insecticides.

Ex. Brinjals and chilies are usually attacked by fruit borer. If flower crop like chrysanthemum flower is grown as a companion crop along with the main crop, then the pest attack can avoided.

List of few companion crops is given below :

10 brinjals + 1 tomato
10 tomatoes + 1 garlic
10 Cabbages + 1 Mustard
Beans + tomato + sunflower
Tomatoes + Chrysanthemum + Onion
Beans + Maize + Cucumber
Watermelon + Cowpea
Groundnuts + Sesame + Cowpea
Beetroot + cabbage + Beans
Carrot + Tomato + Onions + Radish + Tulsi
Banana + Soyabean + Chrysanthemum
Tobacco + Bengalgram + Coriander
Mango + Drumsticks
Chilies + Chrysanthemum
Coffee + Amorphyllus
Coconut + Nag Champa
Flower Plants + Onion
Garlic + any crops controlling Thrips
Potatoes + Wheat / Maize
Ragi + Mustard



SEED PRODUCTION

The most important things that a man requires in life are air, water and light. Food also plays a prominent role in any living beings life. Seed is central to all agricultural activity. Food security of the community is possible only if seed security is provided.

Hence every farmer must concentrate mainly on seed conservation concept. Organic seed production encompasses few specific methodologies like utilization of organic seeds, selection of land, area away from chemical farming, land free from water stagnation, organically produced inputs etc.

Procedure :

1. Different varieties of the same crop should not be planted adjacent to each other.
2. It is better to undertake seed production activity during summer.
3. Seed production should be need based.
4. Good quality ear heads with healthy seeds should be selected for seed production.
5. Seeds to be stored for next season should be dried under shade with minimum moisture content according to the crop.

Select an area free from chemical farming. Initially mix farm yard manure or green leaf manure or vermicompost or biofertilizer into the soil. Neem cake, Pongamia cake can also be mixed in the soil as



biopesticides. The sow the healthy seeds or transplant the healthy seedlings into the main field. At every stage of the crops like growing stage, flowering stage, grain filling stage, earhead emergence stage etc application of jeevamrutha, panchagavya, biofertilizer, vermiwash, fish oil is essential as plant growth promoters. At a plant protection measure poochimarandu or fermented plant based pesticides (FPE or EM-FPE extract) or panchagavya or cow urine or neem oil should be sprayed to the crops or directly applied through irrigation. By adopting these practices, good quality healthy earheads are obtained. Central earhead with healthy seeds are selected for seed purpose and collected separately in a cotton bag. Finally seeds are stored under different procedures with minimum moisture content for storage.

Seed Procurement :

The farmers involved in organic farming should be encouraged to grow crops organically so that the seeds obtained would be procured under the federation. This would help farmers to produce seeds in large quantity as seed security for the future and market assurance.



SOIL TESTING

Soil testing is as important to agriculture as health check is for a human being. The soil that supports the crops has to be very healthy and fertile. Soil testing is very essential to determine its fertility status and simultaneously identify the deficiencies. The farmers can make use of nearby farmers friendly centres, concerned officials and NGO's who will help the farmers in getting the soil tested by scientific techniques.

Ingredients :

One shovel
One bag
One small plastic cover
Label

March – June is the most suitable period for soil testing.

Steps to be taken for soil testing :

Soil must not be taken from the following areas :

1. The fertile part of the land
2. From water logged areas
3. Near the bunds
4. Where the fertilizers have been stored
5. From the tilled area

Selecting the soil for soil testing :

1. Identify 5-6 places in the field by marking in a 'Z' shape.



2. Clean the surface area and dig the soil in a V-shaped pattern to collect about half a kilo soil.

3. Similarly collect the soil from six different spots of the same area and mix well. Spread it on the ground under shade in a circular shape.

4. Divide the circle into four quadrants and discard the soil from two opposite quadrants.

5. Again mix the remaining soil and repeat the same process until you obtain one kg of soil.

6. Dry this soil in shade and collect it in a plastic sheet.

7. Neatly label the soil sample consisting of the farmer name, village, survey number, crop grown previously and the date of soil sample collection.

8. This soil is finally sent to the laboratory for soil testing.



SEED TREATMENT

Crops get afflicted with pests and diseases at different stages of its growth by various kinds of microorganisms like bacteria, fungi and others. We can prevent these attacks right from the seedling stage by following seed treatment practices before cultivation.

Different types of crops require different types of treatments.

a. Seed treatment for paddy

Ingredients :

Local/ indigenous egg (hen), salt, water, container.

Procedure :

- * Take 15 litres of water in a 40 litre capacity bucket.
- * Immerse egg in the water to test its purity. The egg is said to be pure if it sinks in water but if it floats vertically. It should be discarded and replaced by a good one.
- * Go on adding the crystal salt to the water by stirring it continuously till 25% of the egg is visible.
- * One kilo of salt will be usually sufficient for one bucket of water.
- * Add 15 kilos of paddy to the water and remove the chaffy seeds that float on water.
- * Soak these seeds in salt water for fifteen minutes and collect the treated seeds of paddy from the bottom of the bucket. Wash it with clean water two times and dry it in shade.

Uses :

- * Eradication of seed borne diseases
- * Prevents seed rotting, damping off, Leaf spot diseases



b. Seed treatment for groundnut

Ingredients :

Neem seeds, Agaves strips, cow urine, water and a container

Procedure :

- * Pound the neem seeds well and extract juice by addition of water.
- * Heat four or five agaves strips at low flame and extract the juice by wringing.
- * Mix the neem juice and agaves juice in one litre of cow urine and soak it overnight.
- * Add 10 litres of water to this extract next morning.
- * Sprinkle this mixture on the groundnut seeds used for sowing and mix thoroughly with hands before sowing.

Uses :

It can be used against diseases like seed rot, root rot, wilt and pests like ant and root grub.

c. Ragi seed treatment

Ingredients :

cow urine, water and a container

Procedure :

- * Collect cow urine in a container for about fifteen days.
- * Add 10 litres of water to one litre of cow urine and mix well.
- * Add 10 kgs of ragi seeds to the mixture and stir well.

* Soak the ragi seeds in this mixture for half an hour and discard the chaffy seeds and dust particles that float on the solution. Take out the soaked seeds and dry it in shade.

* Now the seeds are ready for cultivation

Uses :

The treatment controls many types of pests and diseases that attack the roots, leaves and the crops.

d. Millets and Sorghum treatment

Ingredients :

Milk asafetida (not the cooking asafetida) water and a container

Procedure :

* Add 100 Gms of milk asafetida to 10 litres of water and prepare a solution.

* Add 6 to 8 kgs of maize seeds to this solution and soak it for 15 minutes.

* Similarly add 3 Kgs of millets to this solution and soak it for 15 minutes.

* Remove the half filled immature seeds and dry them under shade.

Now the seeds are ready for cultivation.

Uses :

The treatment controls diseases that attack the maize and millet crops.

*Remaining asafetida solution can be used for vegetable plants so that the deflowering is reduced and the yield of vegetables is high.



Crops are mainly affected by bacterial and fungal diseases. To avoid these diseases and obtain healthy growth and yield of a crop, seed treatment is necessary. Different methods of seed treatment are followed for different crops like :

e. Bio-Fertilizer Seed Treatment To Control Pests And Diseases

Materials required :

Biofertilizers like Trichoderma and Pseudomonas,
Jaggery, Water, Container

Procedure :

Add 100 gms Jaggery to 1 litre water in a container and prepare a jaggery paste by heating it on low flame for 5-10 minutes. Cool the solution and add the biofertilizer into this jaggery paste @ 4gms of Trichoderma and 4 gms of Pseudomonas to 1 kg of seeds. Add the seeds to be treated into this container and mix well so that the biofertilizer is smeared properly over the seeds. These seeds are dried under shade and used for sowing. All type of vegetable seeds, fruit crops and food crops can be treated using biofertilizers.



f. Seed Treatment Using CPP Manure

Ingredients :

CPP Manure & water

Procedure :

This can be used for all the types of crops. Water has to be sprinkled over the seeds and CPP manure (@ 5-10 grams of CPP manure is applied to 1 kg seeds) has to be applied on the seeds. It is mixed well and dried under shade before sowing.

g. Milk Seed Treatment

This is one of the seed treatment usually done to rejuvenate all type seeds (food crops, pulses, vegetables, oilseeds) that are stored for about 2-3 years.

Ingredients :

Milk water and container

Procedure :

200 ml milk is added to one litre water in a container. Pour approximately 2 kgs of seeds into this mixture and soak it for about 15-30 minutes. Remove the seeds and dry them under shade before sowing.



MULCHING

Mulching is suitable for long duration and wide distant plants. It is mainly undertaken during summer season to reduce evapotranspiration and irrigation.

Mulching is a way of avoiding direct sun rays falling on the crops by covering the plants with waste materials like banana leaves, coconut leaves and grass.

Ingredients :

Dry paddy grass, Dried Banana leaves, Dried Coconut leaves and other waste materials.

Procedure :

Collect the raw materials used for mulching and heap in one place. Cover the banana, vegetables, fruits and mulberry plants completely with mulching materials in the summer months (Nov. June). The raw materials are either spread on the ground leaving a space for passage or mulched around individual plants. Before mulching is undertaken, care should be taken to see that there are no weeds in the plot.

Uses :

Maintains moisture and reduces repeated irrigation
Controls the weeds and reduces labour cost on weeding.

Materials get converted to good farm manure. Maintains soil structure around the plants and inturn help in insitu vermicomposting High quality vermicompost is formed in the mulched area.



KITCHEN GARDEN

Kitchen gardens also called as backyard gardens have also contributed largely in conserving the vegetable diversity which was fast diminishing. It provide fresh vegetables, fruits, medicinal plants and flowers necessary for daily utilization of the family at a reduced cost.

Methods to prepare a kitchen garden :

- * The space to be used for cultivation of kitchen garden must be thoroughly cleaned by removing weeds, grasses and stones. The soil should be loosened and mixed thoroughly with sand, good quality farm yard manure and vermicompost. The soil must neither be too wet nor too dry.

- * Prepare raised beds of 1ft X 3ft dimension so that seeds can be sown in two rows.

- * Similarly two feet wide path should be left for comfortable movement. Water is allowed to stand in the furrows left inbetween the raised bed and path before sowing to maintain the moisture in the bed

- * Depending on the elevation of the land, small bunds must be prepared in these furrows at distances depending on the slope to avoid the wastage of water in the raised beds. Sprinkle the manure on the beds before sowing the seeds. Seeds must be sown in two rows in these raised beds at a depth of 1-1 ½ inches.

- * To avoid evapotranspiration, mulch the bed with dry waste materials till the seeds germinate.

- * After the seeds germinate, regular watering is done once in two or three days

- * Once the plants attains certain height, earthing up needs to be done to strengthen the plants.

It is suggested to have a diversity of more than 15 varieties while growing greens vegetables and fruits. Suggested varieties for kitchen garden include coriander, methyl asparagus, ladies finger, tomato, brinjal, green chillies, bitter guard, ridge guard, pumpkin, drum stick along with lemon, papaya, guava, orange and flowering plants.



DRIP IRRIGATION SYSTEM

Drip irrigation is a water-saving technology which enables slow and regulated application of water into the root zone of the plants. The drip irrigation technology frees the farmer from the limitations of rain fed farming, can cultivate all the year round, and do priority farming.

Advantages of Drip Irrigation :

1. Large area of land can be brought under cultivation with less requirement of water.
2. Weeds can be controlled effectively.
3. The area surrounding the plants is always moist ultimately keeping the soil structure in tact. This helps in proper growth of roots to a deeper extent.
4. Labour requirement is reduced.
5. No chance for soil erosion.
6. Moisture conservation along with increment in yield can be expected to a greater extent.
7. Effective utilization of moisture directly to the root zone.
8. Drip irrigation is most appropriate for small and marginal farmers to cultivate crops in smaller areas and kitchen garden crops.



SEED STORAGE CONSERVATION PRACTICES

India being an agricultural country, it is very essential to protect the yield of crops as seeds and grains. It is a matter of great satisfaction that farmers use traditional methods to protect the seeds from pests and diseases. Few seed conservation practices are highlighted below :

1. Sand application – mainly for Turdhal and Field Beans
2. By mixing green leaves – Paddy and some pulses
3. Mixing castor powder, chili powder and salt
4. Sand Mixing
5. Tall grass tying method
6. Stamping method
7. Soil container protection method.

a. Soil application Method

Mix red soil and water to form a paste in a container. The paste prepared should be such that it sticks to the grains. Transfer the seeds to be stored into this pot and mix well. See that the soil completely adheres the seeds. Dry these seeds under shade. Transfer these seeds into a gunngy bag. Mix ragi husk into this bag in a proportion of 2:20 (2 kg ragi husk : 20 kg seeds). Tie the bag tightly and store in dark.



b. Mixing of leaves

Select leaves having pesticidal property like neem, Vitex nigundo, Clerodendron, etc and dry them under shade. Mix these leaves with seeds of paddy or all types of beans or pigeon pea and fill in the bags. Tie the bags tightly and store in dark.

c. Mixture of castor powder : chilli powder and salt method

This method is most suitable to store different varieties of beans especially Dolichos sp. Dry the beans seeds in morning sun for sometime. Take some small quantity of castor seeds in a bowl, roast it for sometime and powder it. Mix $\frac{1}{4}$ kg castor powder with 1 kg beans seeds (maintain the same ratio of 0.25 : 1 for large quantity of seeds) and store it in a mud pot. Close the lid of the pot and seal it with cow dung to avoid aeration.

d. Stepping method or Salt and Chilli powder application method

Apply $\frac{1}{2}$ kg powdered salt and 250 gms dry chilly powder to 25 kgs horse gram seeds and fill it into a 30 kg capacity plastic bag. Tie it with a thread tightly and keep the bag near the door where people walk often. Repeated stamping of this bag would not only avoid pest attack but also destroys the eggs and maggots that are already present in the seeds. This method also known as stamping method prevents the horse gram from pest attacks and could be stored upto one year.

e. Sand mixture method

Take a 5 kg capacity mud pot. Any variety of seeds to be stored are collected, cleaned and dried under sun and shade. Into this pot, add a thick layer of sand at the base and spread the seeds to be stored over this sand. Again add sand over the seeds. Continue the same process of filling sand seed mixture layer by layer till it reaches upto the brim of the pot. See that the upper layer is again a thick layer of sand. Close the container with a lid and air tight it with cow dung paste. By doing so, you can store the seeds for more than a year. There is a belief that a person who stores the seeds should only open it to obtain quality seeds.



f. Moode method

Moode is a container made of ropes of bamboo stripes, paddy straw, kodo millet straw and some fibrous weeds (hanchi hullu). Arrange the weeds to form a basket. The structure must be air tight with 3 ½ feet height and 30 cms radius. The top and base of the container are lined with ragi husk and the grain/seed to be stored are filled in. Red chilli powder is mixed with the seeds before storage. Close the container with bamboo lid and tighten it with bamboo straw. This method is usually used



to store seeds and grains of pulses, cereals, oilseeds etc for nearly 6-10 months and can be considered as one of the most effective methods of conserving seeds. However, the moode cannot be opened to monitor grains and cannot be reused for next year.

g. Cement granary (Kanaja) or tomb (Vade) method of storage

Kanaja is a surface storage device prepared from cement or mud. In a cement granary or a mud floored storage, about 10 cms. height ragi husk is spread as a basal layer. Now fill the cement granary with ragi seeds / grains till the brim and close it with wooden plank. So preserved ragi seeds or grains can be stored upto 3 years.

Vade is another storage device prepared from mud in tomb shape. Ragi or paddy seeds and grains are filled into this vade and closed with a lid to avoid aeration and light.

This method of storage is very effective and helps farmers rescue from pest attack to seeds or grains. It is usually undertaken during summer in the month of March.



II. Organic Manures

FARM YARD MANURE

Farm Yard Manure is a decomposed organic matter obtained by the action of microbial population in a warm and moist aerobic environment using cow dung, cow urine and other waste materials available from their backyard cattle.

Ingredients :

Cow dung, cow urine, left over cattle grass, old FYM, other farm waste, dry coconut leaves/ shells, egg shell powder, ash powder, wooden barks / stones, water

Procedure :

Select a plain area free from stones, weeds and stagnating water. Dig a pit of or make a rectangular area of convenient size (15-30 feet length X 4 1/2 -5 feet breadth) above the ground using wooden barks or stones to prepare FYM. At the base spread few coconut leaves or coconut shells on the ground. Add 4-5 feet cowdung slurry to avoid pests and disease causing organisms. Above this layer, add agricultural waste materials like banana leaves, stem, dry fodder, rice bran, fresh green plants, weeds etc Again add a layer of cowdung slurry over it. Add another layer of agricultural waste materials, egg shell powder and ash powder. Sprinkle the same with cowdung slurry and water to maintain moisture level. Inoculate the pit with 4-5 kgs. of old farm yard manure for early and complete decomposition of the manure. Turn the contents in the pit for better aera-



tion, easy decomposition and avoid foul smell. Provide proper shade above the pit by roofing and maintain moisture content in the pit by watering every week to obtain good quality FYM. Cover the pit using coconut leaves and allow it to decompose upto 3 months. So formed FYM is black in colour and ready for application.

Dosage :

12-15 cartloads of farm yard manure can be applied to one acre of land during the time of ploughing or land preparation

Uses :

The farm yard manure houses plenty of microorganisms that helps in increasing the soil fertility status. It helps in water holding capacity of the soil. Farm yard manure supplements the essential nutrition required by the crop for its growth and development.



LOW COST VERMICOMPOST

Vermicompost is rich manure obtained by the action of earthworms on organic material. Composting is a process of decomposing organic matter by a microbial population in a warm and moist aerobic environment. Vermicompost is prepared in pit of different sizes, on the land or the worms are just left in the field with organic wastes. It acts as low cost vermicompost, since the products are agriculture waste, without much investment.

Low cost vermicompost is prepared by using agricultural wastes obtained from the field with no external inputs. It is rich manure obtained by the action of earthworms on organic material.

Ingredients :

Cow dung, water, cow urine, agricultural waste materials

Procedure :

Prepare a pit or select an area above the ground of about 6 ft length X 3 ft breadth X 2 ½ ft depth (height). Slightly dig the soil to place the stones / bricks around the selected area above the ground. Initially a thin layer of cowdung slurry is spread evenly on the surface to avoid termite attack. Tree barks are spread on the ground as an initial layer in both horizontal and vertical direction. All dry agricultural wastes are added to a height of 3-6 feet above the ground. Cow dung slurry and cow urine is sprinkled over this layer and another layer of dry material or dry tree leaves, biomass, weeds, banana stem or any waste material is heaped. Above this, another layer of cowdung slurry is added. Biomass contains microorganisms that helps in better decomposition of the compost.



Water is sprinkled evenly to soften the materials. The bacteria in the water helps to early decomposition of the compost. Egg shell powder and ash powder is sprinkled on this layer. Egg shell helps to supplement calcium while ash powder supplies potash. Over this, red soil is sprinkled and finally covered with dry material. Proper shading is provided over this pit.

So formed heap is allowed to decompose for 25-30 days. The pit or heap is then inoculated with earthworms after 30 days of decomposition when the raw materials turn to black. This is finally covered with dry waste over which water and cowdung slurry is sprinkled evenly everyday to maintain moisture. Mix soil in water and plaster the entire heap above the ground with the same to avoid evapotranspiration. For better aeration, make a small hole at the centre. Care should be taken to provide shade throughout the process and even during storing. So formed vermicompost is ready in 40-45 days and can be stored in gunny bags under shade for 4-6 months.

Quality of the compost :

Good quality compost should be black, powdery and fully decomposed material. After every three months, pit should be changed so that there is complete decomposition. Dung slurry and urine should be applied to maintain moisture. Providing shade is necessary to avoid evaporation. Usage of microbes should be made effectively. Moisture should be maintained at 30-40% in the compost which indicates by formation of ball of vermicompost and breaks after falling. Complete three months is necessary for decomposition to obtain good quality compost. Such compost provides all the 16 nutrients required for growth and yield of crops. This compost when mixed with soil helps in water holding capacity, promotes faster growth of plants, increases crop yield and lowers risk of crop loss due to pest attack.

ENRICHED VERMICOMPOST

Enriched, vermicompost is an organic manure that enriches the soil with nitrogen, phosphorus and potash making it available to plants in required form. The fertility of the soil is also maintained due to the action of microbes. Simultaneously it also protects the crop from pests and diseases.

Ingredients :

1. 1 quintal vermicompost or good quality farm yard manure
2. 1 kg Azospirillum or Azotobacter
3. 1 kg. phosphate solubilizing microorganisms (PSM)
4. 1 kg Trichoderma
5. Gunny bags



Procedure :

Spread vermicompost on a clean cement floor. Mix all the biofertilizers like Azospirillum / Azotobacter, Trichoderma and Phosphate Solubilizing Microorganisms with small quantity of water to maintain moisture level. Cover the entire material with gunny sacks to avoid evapotranspiration. Every week sprinkle the material with water and turn the entire material upside down to maintain moisture and aeration. Keep covering the entire material with gunny sacs. Continue this process upto 3 weeks to complete the process.

Usage :

Application of 2-5 quintals enriched vermicompost per acre as soil application before sowing directly to the soil is found to be beneficial in supplementing the necessary nutrients required by the crop as well as in combating pests and diseases from seedling stage itself.

GREEN LEAF MANURE

Addition of leaves, stem and other parts of the plant to the soil when they are still green to improve the fertility of the soil is called green leaf manure.

Procedure :

There are two ways of preparing green leaf manure.

1) Insitu green leaf manuring :

Growing various types of leguminous plants like sunhemp, dhaincha, horse gram, niger, cowpea, jute etc. in the field before 15 days of sowing / transplanting and finally incorporating the same in the soil during ploughing.

11) Ex-situ green leaf manuring :

Getting the green leaves, stem and branches from the trees grown outside like glyricidia, cassia semia, jackfruit, pongamia, niger etc and incorporating the same within the soil just 15 days before sowing or transplantation of the crop in the field.

Uses :

* The green leaf manure rots and provides more nitrogen to the plants ultimately saving organic urea application. Addition of various types of green leaves to the soil controls pests and diseases.

* Two to three tons of green leaf manure can be added to one acre of land.

TANK SILT APPLICATION

Silt is a combination of sand and clay particles collected from tanks or lakes in the villages. It is mainly done to improve soil and moisture conservation as well as increase the aeration and porosity of the soil.

Procedure :

The main field before sowing of the crop must be prepared well by ploughing and bunding along the margins to avoid runoff. Silt is collected in tractors from the tanks / lakes and spread evenly on the surface of the soil. Since silt has adhesive property as it contains kaolinite and montmorillonite, it gets mixed in the main field on the onset of monsoon which inturn help in retention of moisture and nutrients in the soil making it available to plants.

Usage and dosage :

20-25 tractor loads of silt is needed for 10 acre of land. Silt can be applied to the soil once in 3 years.

Uses of silt application :

Application of silt in the main land helps in retention of nutrients in the soil and increases the fertility of soil which inturn increasing crop yield. Application of silt increasing the water holding capacity of the soil providing moisture throughout the growing season of the crop. Silt application can convert barren land into fertile soil. Silt application can be applied to any type of soil but best suited for soils having sandy / sandy loam property. Silt application helps to increase the water table of the soil.

Before application of silt, farmers have to get their soil tested and complete knowledge of silt content from the soil testing laboratory and take necessary steps as per the lab recommendations.



ORGANIC UREA (SAND UREA PREPARATION)

Organic urea is a lowcost organic fertilizer (a substitute for chemical urea) with a mixture of sand and cow urine that supplements nitrogen to the crops.

Ingredients :

Locally bred cow's urine and sand

Procedure :

Construct a pit of convenient size 3 feet length X 1.5 feet width X 1 feet depth lined with brick and cement. Fill $\frac{3}{4}$ of the brick tank with sand. Pour 5-10 litres of locally bred cow's urine over this sand. Keep pouring the locally bred cow's urine for 20 consecutive days in the tank filled with sand. Close the tank with wooden / metal lid to avoid evaporation of urea fumes. Allow the sand to react with cow's urine in the tank. The sand turns black in color within 25-30 days. Remove this sand urea from the tank and dry it under the shade for 3-4 days. Now the organic sand urea is ready for use.

Note :-

Farmers have to make sure that the sand turns black before using it as manure.

Usage and Dosage :

Compost should be applied as a basal dose to the crops. As a top dress, sand urea is applied during vegetative and flowering stage.

In case of ragi, 100 kg/acre (twice or thrice the

quantity of chemical urea) is applied two times – once after 25 days of sowing and another after 45 days of sowing.

In case of paddy, 250 kg/acre (twice or thrice the quantity of chemical urea) is applied three to four times. two times during growing stage and once or twice during flowering stage of the crop.

Uses of organic urea :

Organic urea can be applied for the crop instead of chemical urea. Organic urea provides sufficient amount of nitrogen to the plants making the crop grow healthy and sturdy.

Organic urea must be applied 3-4 times for paddy crop and 1-2 times for ragi crop to get good yield.

Organic urea can be applied directly to any kind of crop.

Before sowing sesame seeds into the soil, instead of mixing the seeds with plain sand, it is convenient to mix with sand urea and sow in the field.



III. Crop Plant Protection Measures

POOCHIMARANDU (HERBAL SOLUTION)

Poochimarandu is a plant based herbal insecticide used against different types of leaf eating and pod boring caterpillars and to some extent against sucking pests. Poochimarandu can be used for all crops and is known to prevent a wide variety of pests on field crops, vegetables and plantation crops. It is also effective against coconut mite when applied at the immature stage of coconut formation. It can also be used as a growth promoter in vegetables.

Ingredients :

Preparation of Poochimarandu :

Material – 1 kg. neem leaves, 1 kg Vitex nigundo leaves, 1 kg. Clerodendron leaves, 1 kg. Calatropis leaves, 1 kg. Aloe vera, 2 litres water and a plastic drum or a mud container with a lid.

Procedure :

Crush all the leaves separately with required quantity of water. Then mix all the crushed leaf extract into a plastic drum or a mud pot. Add approximately two litres of water and stir the entire solution thoroughly. Close the lid of the container and keep this solution for seven days by stirring the solution once in a day upto seven days. Then filter the solution and use it to spray the crops. This solution must be used within a period of three months.

Usage :

60 ml. of poochimarandu solution is mixed in 1 litres of water and sprayed to the crop.

The mixture can be used twice in a period of 10-12 days interval if the pest attack is on a high scale.

As a precautionary measure, it has to be sprayed during flowering and earhead emergence stage.



EFFECTIVE MICROORGANISMS FERMENTED PLANT EXTRACT (EM-FPE)

Fermented Plant Extract is a plant based pesticide prepared by using herbal plants containing pesticidal property. It is effectively used to control the diseases and pests that attack vegetable crops, paddy, ragi and fruits.

Ingredients :

Effective Microorganisms stock solution, Jaggery, Water, container with a lid, Fresh leaves of Adathoda vasicca, Vitex nigundo, Lantana camera, Calotropis sp., Clerodendron leaves, Neem leaves, custard apple leaves

Preparation of Activated Effective Microorganisms :

To prepare AEM, EM solution (300 ml) is mixed in jaggery solution (3%) to activate the microorganisms.

Procedure to prepare 10 litres solution of FPE :

Take 20 litres capacity container. Fill the container with finely chopped leaves used to prepare FPE in equal proportion (1/2 kg each) to 35% capacity. Add 5.9 litres of water (59%) to this container. Add 300ml (3%) AEM and 300gms (3%) Jaggery dissolved in the water to the container. Stir the mixture thoroughly with a bamboo stick and close the lid. Stir the solution twice a day for a week. After fermentation, the pH must be in the range of 3.5-4. This solution should be used within 6 months.

Procedure for usage :

Keeping in view the intensity of the pest attack, 10-20 ml FPE solution is mixed in 1 litre water or 100-200 ml FPE solution is mixed in 10 litres of water and sprayed to the crops. Depending on the intensity of pest attack, FPE is sprayed more than three times at an interval of 10-12 days if necessary. As a precautionary measure, it has to be sprayed during flowering and earhead emergence stage.



AGRICULTURAL FORMULATIONS OR HERBAL PESTICIDES

Herbal pesticides are very useful in sustainable agriculture practices to control pests and diseases. Spraying herbal pesticides as a preventive measure before the onset of pests and diseases is an effective method of controlling pests and diseases. Different types of herbal pesticides have to be administered to the plants at different stages of the crop. Similar form of herbal pesticide should not be used more than twice or thrice for the same crop as the pests gain resistance. The spraying of herbal pesticides not only controls the pests and diseases but also provides good nutrients to the plants.

Few herbal solutions are described below :

1. Pest/Disease : Aphids and other sucking pests.

Ingredients: Tobacco (*Nicotiana tabacum*), Aloe(Aloe Vera), Buttermilk

Method of preparation :

Take 1 kg tobacco snuff (*Nicotiana tabacum*) and 2 kg. Aloe (Aloe Vera) Wash both plants properly and chop it finely and boil with 6 litre water at moderate and constant heat till it remains half. Mix 4 liter supernatant of buttermilk.

Direction of Use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 6 months of preparation.

2. Pest/Disease : Castor semi looper

Ingredients: Tamarindus indica, (Tamarind), Citrus limona (Lemon)

Method of Preparation :

Around 150ml lemon (Citrus limona) juice and 150 ml tamarind(Tamarindus indica) juice is mixed in 15 liters of water.

Direction of Use :

Spray this formulation in 1 Vigha to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use fresh juice and mix with water at the time of spray.

3. Pest/Disease : Larval pest in Pigeon pea

Ingredients :

Capsicum annum (Chilli), Azadirachta indica (Neem), Allium sativum (Garlic)

Method of Preparation :

Take Capsicum annum (Chilli powder, Azadirachta indica (Neem) leaves and fresh Allium sativum (Garlic) in proportion of 1:4:1 respectively. Boil it with 16 times water and keep half (8 times). Filter this solution and use after recommended dilution.

Direction of Use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 6 months of preparation.



4. Pest/Disease : Heliothis in Chick pea

Ingredients :

Adhatoda vasica (Vasaka),
Pongamia pinnata (karanja)

Method of preparation :

Take equal amount of leaves of Adhatoda vasica (Vasaka) and Pongamia pinnata (Karanja) Wash both plant material properly in water and chop it finely and boil with 16 times water at moderate and constant heat until the final volume remains half.

Direction of Use :

Spray 150m l. of this formulation per pump. About 6-8 pumps per ac re are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 6 months of preparation.

5. Pest/Disease : Cotton bollworm and all type of heliothis

Ingredients :

Naffatiyo (Ipomoea fistulosa), Gandhati (Lantana camera), Neem (Azadirachta indica), Tobacco (Nicotiana tabacum)

Method of preparation :

Take 1.5 kg fresh leaves and tender parts of naffatiyo (Ipomea fistulosa) 1kg gandhati (Lantana camera) 1.5 kg tobacco snuff (Nicotiana tabacum) and 1.5 kg neem (Azadirachta indica) in 10 liter water and boil till it remains half. Filter this solution and use after recommended dilution.

Direction of Use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 6 months of preparation.

6. Pest/Disease : Blight disease in cumin

Ingredients :

Azadirachta indica (Neem), Annona squamosa (Custard apple)

Method of preparation :

Take equal amount of Azadirachta indica (Neem) leaves and Annona squamosa (Custard apple) leaves. Wash plant material properly in water and chop it finely and boil with 16 times water at moderate and constant heat until the final volume remains half.

Direction of Use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 6 months of preparation.

7. Pest/Disease : Aphid, white fly and other sucking pests, bollworms, caterpillars

Ingredients :

Lantana camara (Gandhati), Ipomoea fistulosa (Naffatiya), Calatropis procera (Arka).



Method of preparation :

Take equal amount of fresh leaves and tender parts of *Lantana camara* (Gandhati), *Ipomoea fistulosa* (Naffatiya) and *Calatropis procera* (Arka). Wash them in water and chop finely and boil with 16 times water at moderate and constant heat until the final volume remains half.

Direction of Use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result use this formulation within 6 months of preparation.

8. Pest/Disease : Heliothis larvae in chick pea

Ingredients :

Pongamia pinnata (karanj) *Dhatura metal* (Dhattura)

Method of preparation :

Take equal amount of fresh plant material of *Pongamia pinnata* (Karanj) and *Dhatura metal* (Dhattura) and wash them in water. Chop in fine pieces and boil it with 16 times water in constant heat until it remains half in volume.

Direction of Use :

Spray 150 ml of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there. For best result, use this formulation within 5 months of preparation.

9. Pest / Disease : Termite

Ingredients :

Karanj (Pongamia pinnata), Neem (Azadirachta indica)

Method of preparation :

Take 3.5 karanj (Pongamia Pinnata) leaves and 3 kg neem (Azadirachta indica) leaves. Wash all the ingredients properly and chop it finely and boil with 10 liter water at moderate and constant heat until the final volume remains half. Mix 1 liter castor oil after filtration. Add soap nut (Sapindus emarginatus) powder to emulsify oil contents.

Direction of use :

Spray 150 ml. of this formulation per pump. About 6-8 pumps per acre are required to control the infestation. Spray after 10-12 days if infestation is still there.

For best result, use this formulation within 6 months of preparation.



CHILLI-GARLIC-GINGER EXTRACT

This is also used as herbal insecticide for immediate control against leaf eating caterpillar, pod borer and sucking pests.

Ingredients :

Mud pot or plastic bucket, Green chilli 0.5 kg, ginger 0.5 kg, garlic 1 kg, tobacco leaves 0.5 kg, neem oil 200 ml and 1 packet of shampoo

Procedure :

Crush green chillies, ginger, garlic separately with required quantity of water. Soak tobacco leaves in 1 litre hot water overnight and take the solution for use. Mix 200 ml neem oil with one packet of shampoo (use of shampoo is to mix thoroughly neem oil and water). Then mix chilli, garlic and ginger extract and tobacco leaf extract and neem oil in a mud pot or plastic bucket and close the lid. Keep this solution for 1 or 2 days and apply to the crops. This solution should be used within 3 days of preparation.

Application :

10 ml of the solution is diluted in 1 litre of water and sprayed to crops for effective control of pests. Spraying is done regularly at an interval of 10-12 days during flowering and fruiting stage.

Crops sprayed – Most effective in Paddy, Redgram, Field bean, Banana and Vegetables.



BEEJAMRUTHA

Beejamrutha is a very good plant based pesticide to control seed borne diseases that attack the seeds. Smearing the seeds with Beejamrutha before sowing controls many diseases that attack the plant right from its seedling stage.

Ingredients necessary for Beejamrutha

1. 20-25 kg capacity plastic drum
2. 10 litres indigenous cow urine
3. 10 kgs indigenous cow dung
4. 1 kg jaggery
5. 100 gms lime solution mixed with 50 gms turmeric powder.

Procedure :

Mix 10 litres of cow urine, 10 kgs. of cow dung and 1 kg. powdered jaggery in a clean drum. Add 100 gms of lime solution and 50 gms. of turmeric powder into the drum. Stir the entire content in the drum properly until a paste is formed. This paste is applied to the seeds 30 minutes before sowing and dried under shade (400 grams of beejamrutha is applied to seeds required for one acre land). Tuber crops, banana suckers or other seedlings like chilli, tomato are dipped in this solution before transplantation.

This helps to avoid seed borne diseases and other diseases that attack the crop during its growing stage.

Usage :

As Seed Treatment - (400 grams of beejamrutha is applied to seeds required for one acre land) 30 minutes before sowing and dried under shade.



BIOFERTILIZERS TO CONTROL DISEASES AS SOIL APPLICATION

Biofertilizers like *Trichoderma viridae* and *Pseudomonas fluorescense* are soil borne organisms known to combat against diseases effectively. Application of these microorganism to seeds or soil not only controls the disease but also acts as plant growth promoting substances.

Procedure :

Mix 1 kg *Trichoderma* and 1 kg. *Pseudomonas* to 100 kg. already prepared farm yard manure or vermicompost on a cement floor 15 to 20 days before application to the soil by covering with gunny bags to avoid evapotranspiration and maintaining the moisture level by sprinkling with water.

Every week sprinkle the material with water and turn the entire material upside down to maintain moisture and aeration. Keep covering the entire material with gunny sacs. Continue this process upto 3 weeks to complete the process.

This manure can be applied twice once during sowing and other during seedling stage for better effectivity.

Usage :

1-2 quintals per acre of this manure can be applied to the soil. Controls plant diseases and provides good nutrition to the seedlings for healthy growth of a plant.



PANCHAGAVYA PREPARATION

Panchagavya is the single organic input that acts as a growth-promoter and immunity booster. Panchagavya has been one such piece of wisdom, meant to safeguard all the human beings, animals, plants and microorganisms that dwell on the earth's surface. It consists of five products from the cow dung, urine, milk, curd and ghee. When suitably mixed and used, these have miraculous effects.

Ingredients :

1. Cowdung slurry (from gober gas plant) 4 kgs
2. Indigenous cow dung 1 kg
3. Cow urine 3 ltrs.
4. Indigenous cow milk 2 ltrs.
5. Sour Curds 2 ltrs.
6. Ghee from cow 1 kg.
7. Sugar cane Juice 3 ltrs or Jaggery 1 kg.
8. Tender Coconut water 3 ltrs.
9. Over ripe banana 12
10. Toddy (Neera if available) 2 ltrs

20 litres of panchagavya can be prepared from the above mentioned products.

Procedure :

All the above items can be added to a wide-mouthed mud pot, concrete tank or plastic cans in the order specified above. The container should be kept open but in the shade. The contents are to be stirred twice a day, both in the morning and evening. The panchagavya stock solution will be ready after the 7th day. Care should be taken not to mix buffalo products. The products of local breeds of cow are said to have more potency than exotic breeds.



Alternative method :

In places where gobar gas slurry is not available, the following method can be used. Add 7 kgs. of fresh cow dung to 5 litres of cow urine and 5 litres of water and keep in a suitable container in the shade. The container should be kept open for aeration and to allow the gas produced during the fermentation process to escape. Mix thoroughly and stir the solution twice daily for 15 days. On the 16th day, add the rest of the ingredients and continue stirring twice daily. On the 22nd day the panchagavya will be ready for use. If sugarcane juice is not available, add 500 grams of jaggery dissolved in 3 litres of water. Likewise if toddy is not available, add 100 grams of yeast powder and 100 grams of jaggery to 10 litres of warm water. After 30 minutes, add this solution to replace toddy in Panchagavya. When stirred twice daily, the Panchagavya solution can be kept for 6 months without any deterioration in its quality. Whenever the solution becomes thick due to evaporation of water over a long period, suitable quantity of water can be added to keep it in a liquid state.

Uses and proportion

For spraying :

3 litres of panchagavya has to be mixed with 100 litres of water and sprayed to all type of crops. The power sprayer of 10 litres capacity may need 300 ml tanks of Panchagavya. When sprayed with power sprayer, sediments are to be filtered and when sprayed with hand-operated sprayers, a nozzle with higher pore size is to be used.

For Irrigation purpose :

20 litres per acre of panchagavya can be used along with irrigation water either through drip irrigation or flow irrigation.

Seed / seedling Treatment :

30 ml. of panchagavya has to be mixed with one litre water and seeds have to be soaked for 20 minutes. Seeds have to be dried in the shade and used for cultivation. this solution, takeout after some time dried and stored

Seed procurement :

Three percent i.e., 3 ml of panchagavya has to be mixed with 100 litres water to drench the seeds, soak or dip the seedlings before planting. 20 minutes soaking is sufficient. Rhizomes of turmeric, ginger and sets of sugarcane can be soaked for 30 minutes before planting.

Seed Storage :

Three percent i.e., 3 ml panchagavya has to be mixed in 100 litres of water and used to dip the seeds before drying and storing them.

Periodicity of application :

* This panchagavya solution has to be used once in 10 or 15 days depending on the duration of the crops.

* Pre-flowering phase (20 days after planting)

* Flowering and pod setting stage (Fruit / pod maturation stage)



COW URINE

Cow urine that is locally available is used to prevent plant diseases, as growth promoter as well as seed treatment.

Ingredients :

Cow urine, water, plastic drum / earthen pot / any container

Procedure :

Dilute 1 litre cow urine in 10 litres of water in as plastic drum or earthen pot. Add the germinated paddy seeds into this solution and allow it to stand for 30 minutes. Dry these under shade and use them for sowing. This prevents the attack of leaf spot disease in paddy.

Usage :

1 litre cow urine is added to 10 litres of water and sprayed to the crops as foliar application to controls pests, and simultaneously provide required nutrients especially nitrogen.

Cow urine treatment helps to increase the yield of crops. It is also used to prepare Sasyamrutha, Jeevamrutha, Beejamrutha and many other agricultural applications.



SASYAMRUTHA PREPARATION

Sasyamrutha is one of the liquid fertilizer made by fermenting cowdung and cow urine along with different types of leaves in an appropriate proportion having medicinal value.

Sasyamrutha plays some important specific roles in providing required nutritional benefits to the crops along with pest/disease resistant characters.

Ingredients :

1. Indigenous cow dung – 30-40 kgs
2. Indigenous cow urine 3-5 litres.
3. Plants having latex (Milk hedge, Calatropis, Jatropa, Sweet scented oleander) - 3-5 kgs
4. Plants having strong aroma (Parthenium, Lantana, Eupatorium, Cassia, Datura) – 3-5 kgs
5. Oil cake (Groundnut, Pongamia, Neem) - 1-2 kgs.
6. Jaggery – 1 kg
7. Ash of Agnihotra – 500 gms
8. Water - 200 litres
9. A container with a capacity of more that 200 litres.

Procedure :

Chop all the plant materials into finer pieces. Clean the drum well and fill it with the finely chopped plant materials. Add 200 litres of water and all other ingredients into this drum like indigenous cowdung, and cow urine, oil cake, Agnihotra ash, Jaggery in the



mentioned quantities to the drum. Stir well and close the drum with a lid and allow it to ferment for one week. Daily stirring of the solution for aeration should be done. After a week the whole mixture must be filtered and sasyamrutha has to be collected in another drum. The filtered leaves and green should be collected in a separate container and can be used in the fields along with water.

Usage :

Filtered sasyamrutha liquid manure is given through irrigation water @ 200 litres per acre. Sasyamrutha also helps to control pests and diseases

Sasyamrutha can be prepared once a month and can be used for the crops in the field at different stages of the crops like growing stage, flowering and grain filling stage.



IV. Plant Growth Promoters

VERMIWASH

Vermiwash is one of the liquefied fertilizers obtained from the earthworms. Vermiwash spray plays a dual role; it acts as a fertilizer as well as a pesticide. Increase in both quality and quantity of produce in fruit and vegetable crop is observed by spraying this vermiwash.

Ingredients :

1. Plastic Drum
2. Earthworms
3. Small pebbles or brick pieces
4. Sand particles
5. Cow dung
6. Fertile soil
7. Waste grass

Procedure :

Take a plastic drum with 250 kg. capacity and make a small hole at the bottom of the container. Fill the container at the bottom with small stones/pebbles to a height of 1 ½ inches. Add water to test if the water flows out through the hole. Above the stones, fill the container with sand (1 inch) and waste materials like manure, fertile soil, vegetable peels (30-40 cms.) as the food for earthworms. Add one kg of fresh cowdung into the drum and release 200-300 earthworms in the drum. Take a five litre capacity bucket and make a small hole at the



bottom. Fill the bucket with water and place it on the drum so that water drips into the drum. Fill this bucket with water as it turns empty. Collect the vermiwash in a bottle that trickles slowly from the bottom of the drum.

Uses :

Mix one litre of vermiwash with five litre of water and use it for crops. It can be sprayed directly to the crop or applied along with irrigation.

The vegetable plants become very healthy and strong. Controls deflowering and increases the yield of a crop.

Vermiwash mixed wit cow's urine and water in the ratio of 1:1:6 is sprayed to crops for effective control of caterpillars and aphids in vegetable crops.



JEEVAMRUTHA

(20 LITRES SOLUTION)

Jeevamrutha is a plant growth promoting substance containing beneficial microorganisms that provides all the necessary nutritional requirement for growth and yield of a crop. Microorganisms are well activated in the soil by the addition of Jeevamrutha. The microorganisms that supply nitrogen like Azotobacter, Acetobacter, Azospirillum and phosphorus solubilizing bacteria Pseudomonas and potash solubilizing bacteria like Bacillus silicus are present in the dung that is used to prepare Jeevamrutha. Similarly urine has disease resistant organisms.

Ingredients :

Drum, 17.5 litres water, 1 litre cow urine, ¼ kg jaggery, ¼ kg gram flour, 1 kg cow dung, small quantity of fertile soil from undisturbed area.

Procedure :

Add 17.5 litres water into a drum. To this, add 1 kg cow dung, ¼ kg jaggery, ¼ kg gram flour, little soil and 1 litre cow urine. Mix all the ingredients and stir properly. Cover the mouth of the drum with a cloth and keep it in shade. Stir the mixture thrice a day (morning afternoon & night) for 4 consecutive days. So prepared Jeevamrutha should be used from 4th day onwards within 7 days of preparation.

Usage & proportion :

- * 50-200 litres of Jeevamrutha is required for one acre land.
- * Jeevamrutha has to be applied once in 15 days compulsorily during vegetative stage, flowering stage and grain filling stage (@ 250 ml/plant)
- * Jeevamrutha can be applied to the paddy crop along with irrigation.
- * Jeevamrutha can be administered to other varieties, either directly to the roots or the rows in the field.



ACTIVATED EFFECTIVE MICROORGANISM (AEM)

Effective Microorganism (EM) is a dormant inoculum of beneficial microorganisms. This dormant inoculum is activated before its application by adding jaggery solution to make it Activated Effective Microorganism (AEM). EM converts a degraded ecosystem to one that is productive and contains useful microorganisms. It offers the most advanced technology to bring about wide scale benefits to agriculture. EM is a combination of 80 different microorganisms each possessing different characteristics like growth promotion, disease and pest control, soil fertility, soil aeration, soil nutrition etc. AEM preparations made locally out of EM stock solution has different applications.

Farm Yard Manure, Vermicompost and poultry manure may be used to strengthen the AEM.

Ingredients :

Standard Ingredients to prepare one litre AEM solution:
850 ml Water, 100 grams Jaggery, 50 ml EM Solution.

Procedure to prepare ten litres AEM :

Take a ten litre capacity container having a lid. Take 8.5 litre water, 1 kg jaggery (dissolved Jaggery) and 500 ml EM in the container. Stir the solution well with a stick and close the lid. Store the mixture for a week in the container. Stir the mixture well twice a day. The solution is ready for use when pH is between 3.5 – 4.0

Uses :

Strengthens the organic manure. Can be used to prepare Fermented Plant Extract. Disease causing bacteria and unnecessary microorganism can be controlled.

FISH OIL MEDICINE

The mixture prepared by mixing fish and jaggery can be called as the plant promoting fish medicine.

Ingredients :

1 kg fish, 1 Kg jaggery and plastic bucket with a lid

Procedure :

* Chop the fish into small pieces, powder the jaggery and mix the two ingredients in a plastic bucket having a lid. Cover the lid and keep it aside for 15-20 days.

* Stir this mixture everyday to avoid foul smell and odour upto 15 to 20 days
This mixture gives a pleasant fruity odor after complete fermentation

Uses :

Add 6 ml fish medicine to 1 litre water and sprinkle this on vegetable plants once a week.

The vegetables grow very well and the flowering in these vegetable plants increase. Simultaneously the vegetable yield also increases.



AMRITH PANI

Amrith Pani as the name suggests is as important as nectar in our life. It is a foliar spray that provides nitrogen to the growing plants through the leaves. This spray also acts as insect repellent.

Ingredients :

1. 1 litre cow urine of indigenous breed
2. 1 kg cow dung of indigenous breed
3. 250 gms jaggery
4. 10 litres water
5. 1 Drum or plastic bucket.

Procedure :

Clean the drum well and fill it with required quantity of water. Mix indigenous cow dung with water to prepare cowdung solution. Add cow's urine and powdered jaggery. Mix thoroughly the entire ingredients in a drum and keep it closed for one day for curing. 12-13 litres of mother solution is obtained by this method.

Usage :

Dilute one litre of mother solution in 10 litres of water and use as a foliar spray OR 20-30 litres of Amrit pani is applied through irrigation for one acre of land. Paddy, Ragi Vegetables, banana crops can be sprayed with this solution.

Farmers are immensely benefited from this method.



EGG LIME : (MUTTAI RASAM)

(AN EXCELLENT PLANT GROWTH PROMOTER)

Ingredients :

Lime – 20-25; Jaggery – 250 grams; Chicken or duck eggs – 10-15

Procedure :

Take 20-25 limes and squeeze the juice into a bucket. Take about 250 grams of jaggery and mix it well with the lime juice to form a solution. Then take about 10-15 chicken or duck eggs and place it in the bucket containing the solution in such a way that all the eggs are well immersed inside the solution. Close the bucket with an air tight lid and keep it in the shade for about 10 days. On the 10th day, the eggs along with the shells inside the solution would have become rubbery, like a rubber ball.

Thorough Mix – Use your hands to mix the eggs (along with the shell) with the lime and jaggery solution. After thorough mixing, add jaggery solution again in equal measure to the lime jaggery solution. Eg. If 2 litres of solution is prepared, then add 2 litres of jaggery solution. Then close the bucket tightly for about 10 days. After the 10th day the formulation can be used as spray for the crops. About 10-15 ml of the formulation can be diluted in one litre of water and sprayed. The concentration varies according to the area to be sprayed. This formulation can be sprayed for any crops such as paddy, wheat, banana, vegetables, greens and fruit trees. Spraying should be done either in the morning or late evening. It can also be mixed with panchagavya, vermiwash and sprayed. The solution can be stored for about six months. Hence it is advisable to drill small holes in the lid to facilitate escape of gases which emits from the solution.

Methodology developed by Mr. N. Gopalakrishnan
Source : Mr. Prabhu, M.J. In : The Hindu,
dated 18th September, 2008



EGG AMINO ACID (EAA)

Egg Amino Acid is a growth promoter to boost the plant growth and yield.

Ingredients :

Egg – 10 numbers; Lemons – 10-15; Jaggery – 250 grams

Procedure :

Place eggs in a jar and pour lemon juice in it until eggs are completely immersed. Keep it for ten days. Smash the eggs and prepare the solution. Add equal quantity of thick jaggery syrup to it and set aside for ten days. The solution will then be ready for spraying. It boosts plant growth. It was originally conceived by Ms. Veerachinnammal of Theni district (TN) as medicine for asthma.



V. Improved Agricultural Practices

SYSTEM OF RICE INTENSIFICATION (SRI) METHOD OF PADDY CULTIVATION

SRI was developed in Madagascar by Father Henri de Laulanié, a Jesuit priest, in the early 1980's. It has since been tested in China, India, Indonesia, the Philippines, Sri Lanka and Bangladesh with positive results.

Objectives :

- To quantify the difference in water requirement
- To assess the cost of cultivation
- To study the growth and yield
- To popularize the SRI technology

SRI is based on the insights that rice has the potential to produce more tillers and grains than now observed, and that early transplanting and optimal growth conditions (spacing, humidity, biologically active and healthy soil, and aerobic soil conditions during the vegetative phase) can fulfill this potential.

These principles are translated into a set of 'baseline' practices: transplanting of young seedlings, carefully one per hill, with wide spacing; no standing water during the vegetative growth phase; application of compost; and early and frequent weeding.



Procedure :

Seed selection :

Select healthy and good quality seeds. Seed Treatment has to be done (Refer paddy seed treatment). The healthy seeds are cleaned in fresh water for two to three times and soaked in water overnight. These seeds are then tied in a clean cloth and kept aside for 48 hours for sprouting.

Seed bed preparation :

Select a land free from weeds and stubbles. Plough the land 2-3 times and add farm yard manure or vermicompost to it. Level the land and puddle the soil. Sow the pre-germinated seeds (line sowing) that are tied in a cloth in this bed. Allow water to stand in this bed.

Transplantation in the main field :

Main field has to be cleaned and ploughed to soften the soil. Apply Farm yard manure or Vermicompost 300-400 kg / acre . 12 days old seedlings has to be transplanted. Each seedling has to uprooted along with the soil and seed sac adhered to the root without any damage. Dip the seedlings in good quality Jeevamrutha before transplantation.

Transplant seedlings quickly and carefully, allowing only 15-30 minutes between uprooting from the nursery and planting in the field.

Each seedling has to be transplanted at a distance of 1 feet (25-30 cms X 25-30 cms.) in a straight line by holding a plastic thread.

Seedlings should be put 1-2 cms deep into soil that is muddy but not flooded. They should be laid into the soil with care, with roots lying horizontally so that their root tips are not pointing upward.

To maintain the moisture level, water should be allowed to stand in muddy form but not flooded in the main field to a height of about 3-5 cms.

Plant in a square pattern to facilitate weeding. A rotary weeder has to be passed 4-6 times throughout the growing season since SRI method facilitates more growth of weeds. To control weeds, there should be early and frequent weeding. This is best done with a simple mechanical hand weeder often called as 'rotary weeder', after the 10th day of transplantation. This not only removes the weeds but also helps the soil around the plants to loosen thereby helping them to receive lot of air and sunlight. This method also helps the plants to get 60 or more tillers.

Water level should be maintained till the crop reaches harvesting stage. Keep the soil well drained rather than flooding continuously during the vegetative growth period.

Soil is kept moist but not saturated during the vegetative growth period, ensuring that more oxygen is available in the soil for the roots. Flood and dry the field alternating periods of 3-6 days.

Add nutrients to the soil, preferably in organic form such as compost or mulch.

The best results with SRI come from soil that is rich in organic matter and microbial activity.

Uses of SRI method of cultivation :

- * 2 kgs of seeds are sufficient for one acre of land.
- * Water can be conserved upto 35 %
- * The quantity of grass also increases.
- * Good quality yield is observed
- * The pest and disease attack is minimal in SRI method.

Farmers can conveniently adopt SRI method to



SYSTEM OF PLANT INTENSIFICATION (SPI) CULTIVATION

SPI is one of the improved methods of cultivating ragi and dryland paddy by maintaining minimum distance between the plants. Planting two seeds per hill at a distance of every feet can be called SPI method of cultivation. The main purpose of this SPI method is to reduce the quantity of seeds used for cultivation, to increase the number of tillers, simplify weeding and obtain a higher grain and fodder yield.

Procedure :

- * Select the best quality unadulterated ragi and paddy seeds.
- * Treat the ragi seeds with cow urine for 30 minutes and the paddy with salt water for 15 minutes.
- * The land must be ploughed 3-4 times and rows are formed at every feet. Good quality farm yard manure must be mixed in these rows.
- * Maintain a distance of one foot for every two seeds per hill in the row which makes it possible to have at least oneseed to germinate thereby reducing the competition between the seeds. This helps the seeds to get the maximum nutrition resulting in optimum tillers, resistant to pest and disease of the crop and good quality crop.

Advantages :

- * High yield of the crop is assured.
- * It is very easy for weeding
- * Tender Ragi and paddy receive very good sunlight because of wider space between the seedlings making the plants very strong and healthy.
- * Only one to two kilos of seeds are required to cultivate one acre of land In general we can say that the farmer has many advantages in the SPI method but it takes some extra time for cultivation.

GULI VIDHANA IN RAGI

Ragi has been the favorite food for millions of people in the past. It plays an important role in mixed cropping systems that provide the nutrition to the people who farm on marginal lands. In contrast to the food crops like wheat and rice, ragi provide the requirement of minerals, calcium, iron and vitamins besides carbohydrates and proteins. Farmers have continuously practiced need based location specific research on their farms to satisfy the diverse needs of their family. Guli method has been a best example for farmer's wide knowledge in cultivation methods.

Despite resorting to high yielding varieties and application of fertilizers and chemicals, the farmers get at the most 15 quintals of finger millet (ragi) grain yield per acre. But the farmers from around Haveri District, Karnataka, India, practice a unique method of cultivating ragi called as GULI VIDHANA – square planting. The experienced farmers from Haveri district have designed and developed simple steps that can be adopted by any one who desires to follow Guli Vidhana of ragi cultivation and can be adopted in any other place. By following this method they harvest around 18-20 quintals of ragi per acre. Guli Vidhana is simple and similar to SRI popularly known as Madagascar method of cultivation.



Procedure :

Seeds :

Seeds are initially raised in the seedbed and transplanted after 25 days of sowing. The traditional varieties are the most suited for this method. The hybrid and improved varieties are not suited for fodder quality because of its thick stem where animals reject to menace this fodder.

Land preparation :

Plough the land twice and pass the harrow twice to level the land, remove the weeds and bring the soil to fine tilth. If the land is still having clods pass the koradu (wooden plank) twice. This steps helps in seed bed preparation.

Transplantation of ragi saplings :

Plough land twice in both east to west and north to south directions to form the pits. The distance between two rows must be 1½ feet. At the intersection, pits are formed. Apply handful of manure into the pits. In each pit, transplant two saplings of 20-25 days old. Care must be taken not to plant more than 30 days old saplings. 15 days before transplanting incorporate manure to the soil at the rate of 15-20 cart load (7-8 tonnes) per acre. Before transplanting, apply handful of manure or vermicompost into the pits. This step will increase the plant growth and enhances the yield.



Mixed cropping :

Sow the seeds like horse gram, cowpea and sorghum as mixed crops after 15 days of transplantation of ragi saplings. During October and November, horse gram can be sown as inter crop. If seeds for inter crop are sown simultaneously at the time of transplantation, intercrop ratio should be 6:1. In this case, Yadekunte and Koradu must be ploughed in only one direction.

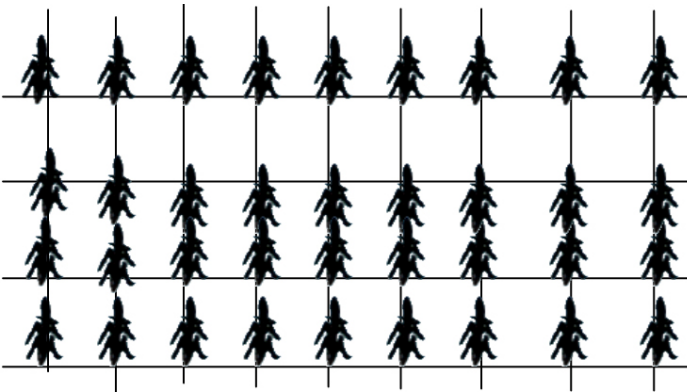
Yield :

According to experienced farmers, the grain yield will be anywhere between 18 to 20 quintals and fodder yield will be 8 to 10 cartloads per acre. The maximum yield recorded was 25 quintals per acre during good agriculture season.

Gulli Ragi Planting System :

Special Features :

The distance between row to row and plant to plant must be 1 feet X 1 feet in marginal soils and 1.5 feet X 1.5 feet in fertile soils to facilitate spreading of root zones.



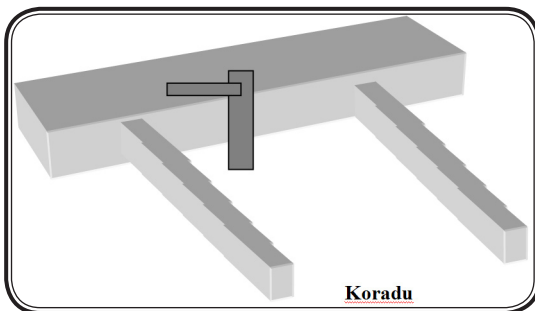
Inter-cultivation – Yade Kunte and Koradu :

The success of Guli method lies in inter cultivation methods. Pass Yadekunte (an intercultivation implement) after a week of transplantation in both east-west and north-south directions. Yadekunte removes the weeds and ploughs back into the soil. Pass Koradu 3-4 times after 25 days of transplantation. This operation encourages the growth of tillers and controls pests at early stages. Koradu operation bends the base of the young seedlings which further promotes the side shoots to develop profusely. Passing Yadekunte 5-7 times and 3-4 times Koradu is compulsory. Yadekunte removes the weed and pushes the soil towards roots (earthing up).

Ploughing by Koradu :

(a wooden implement prepared by using palm tree and hallow at the bottom) helps to break clods and level the land. At seedlings stage, it is passed to increase the number of tillers per plant and control the pests. As a result the yield performance will be high.

Mixed crops are sown 15 days after transplantation of ragi saplings in Guli method of ragi cultivation. Between the two rows horsegram can be sown after 60-70 days after ragi transplanting as a catch crop.



BIODYNAMIC FARMING PRACTICES

In early twenties, some group of farmers in Germany, who were practicing organic farming realized and were deeply concerned with the decline in the soil fertility, loss in the food quality, quantity and the uneconomical animal husbandry. Dr. Rudolf Steiner gave the solution to this as “Biodynamic Agriculture” in the form of eight lectures at Koberwitz. In this method of farming, the farm is considered as a “living organism” in which one activity influence and affects the other. Bio Dynamic agriculture can otherwise be called as a “Holistic farming system”. It encourages the mixed farming with animal husbandry as an important component. It insists on all Organic principles, mainly on green manuring, crop rotation, compost making and its application and natural way of controlling the insect and pest incidences. Apart from these, it emphasizes very much on the utilization of the cosmic forces and the effects of moon rhythms in farming by proper planning of all garden activities using the planting calendar. Biodynamic farming can be practiced and works well only in a good organic farm.

In the Biodynamic farming Dr. Rudolf Steiner has given eight recipes as “Bio Dynamic preparations” that include Horn Manure, Horn Silica and Compost preparation.

Important steps in Bio-dynamic farming are

- * use of planting calendar
- * use of organic farm
- *use of BD preparations

For agriculture, earth and moon movement varies. Steiner has classified all planets into two groups:



- A. Outer planets for silica force: - Mars, Jupiter, Saturn these forms outside structure of the plant (epidermitis) so shape of a fruit is due to this.
- B. Inner planets for calcium force: - Mercury, Venus, Moon.

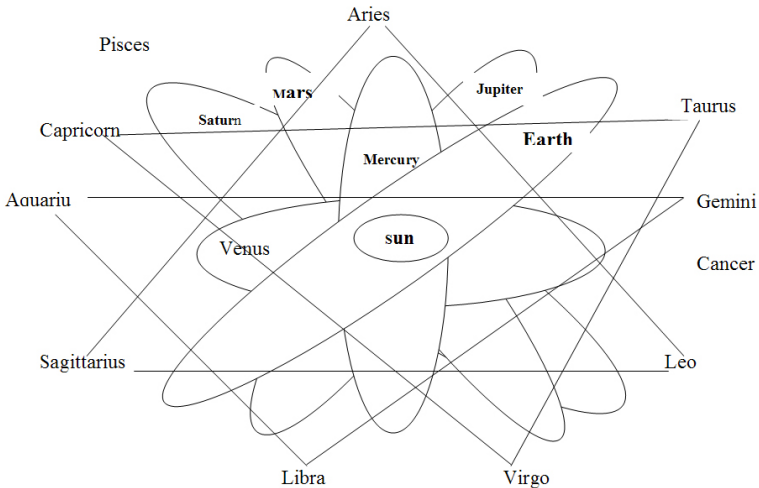
This forms the substance of a plant. Eg: - Mango pulp.

In Bio-dynamic we talk mainly about polarities, i.e. calcium and silica polarity in plants. Calcium pectate is the binding substance between cells. Silica forms outer covering of cells (epidermis)

Once the calcium and silica forces match there is no problem to plants.

For Agriculture, rhythms of the moon is very important. Full moon and new moon occurs once in 29.5 days.

Solar eclipse occurs on new moon day during daytime.



Lunar eclipse occurs on full moon day during nighttime. Moon revolves round the earth in anti-clock wise direction. Earth rotates around its own axis in anti-clockwise direction.

The duration between full moon and new moon - Waning Moon.

The duration between new moon & full Moon day – Waxing Moon.

The four groups represent four different energies and these four energies lie in different parts of the plant.

Earth –Roots – Taurus, Virgo Capricorn

Fire – Seeds – Aries, Leo, Sagittarius

Water – Leaves – Cancer, Scorpio, Pisces.

Air/Light – Flowers – Gemini, Libra, Aquarius

Full Moon Day (Hunnime) occurs once in 29.5 days. Moon is in full form.

Sowing - Seeds can be sown during these period – good quality sprouts can be achieved.

Manuring – Manures in liquid form can be sprayed directly to the crops to control diseases caused by fungus.

New Moon Day (Amavasya)

Moon doesn't appear once in 29.5 days. There is absolute darkness. So, Sowing – Seeds sown during summer leads to good germination and healthy growth of the plants.

Transplanting - Seedlings can be transplanted.

Manuring - Manure can be applied to the soil like - compost, oil cakes, vermicompost.



Period of ascending :

During this period Moon is at a very great height in the sky for a very long period for about 13-14 days.

Activities undertaken during this period are,

- * Sowing of seeds on different days.
- * Herbal pesticides have to be sprayed- BD 501
- * Liquid manure to control fungal diseases
- * CPP manure can be sprayed.

Period of Dissonance :

Moon is at a lower level for a period of 13-14 days.

Activities undertaken during this period are :

- * Transplanting – Yield has to be visualized
- * Plant cutting can also be planted
- * Compost application can be done during this period.
- * Harvesting of root crops

Biodynamic Calendar Sowing :

We can see four important divisions by sowing through Biodynamic Calendar :

Seed / Fruit day

Root day

Flower day

Leaves day

Seed / Fruits Day :

Agricultural activities carried out during these days according to biodynamic calendar help in better growth of a crop, increment in seed and fruit

1. Seeds can be sown (according to period of Ascendancy)

2. Transplantation (Period of Dissonance)

Ex Cereals like – paddy, minor millets etc

Vegetables like - tomatoes and ladies finger

Fruits like - Coffee and sweet lime (Musambi)

Roots Day :

Root crops sown during these days according to biodynamic calendar, helps in better root development

Sowing (period of ascendance)

Transplantation (period of Decadences)

Ex – carrot, potatoes.

Flower day :

Flowering crops sown during these days according to biodynamic calendar, help in better flowering

Sowing (period of ascendance)

Transplantation (period of Dissonance)

Ex- Flowering in medicinal plants, roses etc.

Leaf emergence Day :

Crops sown for leaf purpose during these days according to biodynamic calendar, helps in better leaf yield

Sowing – period of Ascendance

Transplanting- period of Dissonance

Ex – Cabbage, Basle, Tea Etc.

Note : -

Refer Biodynamic Calendar for sowing, seed / fruit day, root, flowering, leaf emergence day



COW HORN MANURE (BD-500)

Farmers have to supply varieties of nutrition to the field if they want to have a healthy agricultural system. During the scarcity of greenleaf manure or farmyard manure, farmers have to supply cow horn manure prepared through biodynamic farming. Cow horn manure is considered to be one of the effective manure that supplies essential nutrients for growth of a crop, helps in moisture retention and also enriches the soil with bacteria and beneficial microorganisms.

Ingredients :

- * Horns of a local breed cow (which has given birth to a calf)
- * Cow dung of the local breed cow

Procedure :

Select cow horn such that it is having the pregnancy rings on the horn and gives a solid sound after tapping. Do not use painted horn. Local cow should be selected to collect the cowdung. Quality cowdung free from antibiotics is used and filled in the horn by tapping slightly without leaving any interspace / cavity / air pocket. Sort the horns according to their appropriate size as small, medium and big.

Dig a pit such that the depth of the pit includes the size of the cow horn and nine inches above. The pit must be dug in a place where the roots do not grow.

Place the horns such that the nodal portion is placed at the bottom and tip at the top. Minimum of 1 1/2 – 2 inches between the horn is placed in between two horns during burying. If the soil is not fertile in the pit, make it so by mixing with compost. Make a groove

and just place the cow horns. Place the top fertile soil around the horns in the pit. Press the tip of the horn in the soil so that it stands upright. After the first row is placed, add adequate soil over it. The second row is started by forming a zig zag shape and make a groove. Second row is placed such that the horns does not fall on the first row and soil is placed in opposite direction to cover the horn. Fill the pit with soil loosely and use some markers at the border above the ground with some dry sticks / bricks. Finally cover the pit with mulch material to maintain moisture. Right time to do cow horn manure is September-October and could be taken out in February-March for application.

Usage :

Take 15 litres of water in a bucket and add 25 gms of horn manure. Stir the mixture with a stick for nearly one hour. The prepared solution can be used for one acre of land and must be administered to all the crops in the same proportion. This manure has to be applied thrice a year to the same soil.

1. Depending on the moisture content, this manure must be sprinkled on the main field during evening hours (in downward form according to biodynamic calendar)

2. Must be sprinkled with Vitex nigundo leaves or Neem leaves.

3. CPP manure can be stored under good condition upto an year in a porcelain jar.



COW PAT PIT MANURE (CPP)

CPP is an organic manure that provides necessary nutrients required for growth and yield of a crop. Application of CPP to the soil activates the micro organisms in the soil which in turn aerates the soil and increases the water holding capacity.

Ingredients :

80 kgs indigenous cow manure, 200 gms egg shell powder, 1 gunny sac, 200 gms rock powder, Few sticks and thatches to make a small shade over the pit, 6 sets of biodynamic mixture (502-507)

Procedure :

Mix 80 kgs cow manure, 200 gms egg shell powder and 200 gms rock powder to a chapatti dough consistency. After one hour this mixture loses the smell of cow dung. A convenient sized pit (approx. 3 ft X 2 ft X 1 ½ ft) with brick lined is prepared to which the above cow dung mixture is filled in. A thick layer of about 6-7 inch is formed inside the pit.

To inoculate the biodynamic preparations (502-506) five small holes are made and that the hole reaches the center of the cow dung mixture layer and also at equiv-distance from each other. In these five holes 3 gms each of biodynamic herbal preparations (502-506) are added and covered with cow-dung.

Add 30 ml BD 507 to 1 ½ litres water and sprinkle it over the CPP pit. After inoculation, the cow-dung mixture layers is fully covered with a wet gunny sac. The pit should be protected from direct sunlight and rain by providing a shade made out of thatches or any other material.

Take out the entire mixture from the pit after 30 days, remix the same and fill it back into the same pit.

Repeat the remixing and refilling procedure after 25 days of first remix and again after 20 days of second remix. So formed CPP manure can be used after 3 months.

Usage and Dosage :

a. Soil application b. Foliar spray c. For rooting
d. Seed dressing e. Root dipping f. Tree paste

Take 15 litres water in a bucket and add 500 gms CPP manure to it. Stir the mixture for 20 minutes both in clockwise and anticlockwise direction. So prepared solution can be applied directly to the soil as well as foliar spray to the crops for one acre area.

CPP must be sprayed at the time of sunset taking care of the moisture content.

CPP should be sprayed using leaves of Vitex nigundo or Lantana camera so that it covers the entire surface area along with the main crop.

CPP mixture can be administered twice in a year, once before sowing and other during growing stage of the crop to know its effectivity.



HORN SILICA MEDICINE

It is a finely crushed silica placed in a cow's horn and buried in summer. It is exposed to the Sun's life forces. Cow's horns are natural energy captors and are largely used in bio-dynamics. These products are used after dynamizing. The process consists in placing the product in water and stirring during a certain amount of time, first in one direction so as to create a vortex, then in the opposite direction. The substance is then transferred to the water.

Application of Horn silica (BD-501) benefits the leaf activity of a plant whereas BD-500 prepares the soil structure for root development. As BD-501 encourages the light (summer) process it aids photosynthesis and so strengthens development. Horn silica can be best used to increase the resistance of the plants thereby supplying sufficient nutrients to the crop.

Ingredients :

1. Horn of the local breed cow
2. quartz crystal (silicon dioxide)
3. Water

Procedure :

It is important that the clear quartz crystal (silicon dioxide) is crushed into a very fine powder. A steel mortar and pestle can be used. The powder can be further ground between two sheets of thick glass until it becomes like talcum powder. Blend this powder with some water until it is dough-like.

Fill this powder into a cow horn and keep the filled horn standing upright overnight with the bottom pointing down for 2 hours and pour off the excess water. Keep

on removing the accumulated water at intervals. Bury the horn (s) in the same way as prep 500. Now take the filled horn and place it pointing upward and keep it under the ground and see that 9 inches of the horn is visible above the ground. This process has to be taken out in the month of October. The silica available in the horn can be sprinkled on the crop.

Usage and dosage :

Take a clean plastic bucket. Add 1 gm prepared silica and 15 litres of water into this plastic bucket and stir the mixture both in clockwise and anticlockwise direction.

This solution must be sprayed directly to the crops in the morning hours by keeping the nozzle in upright position. This solution is sufficient to spray crops for one acre of land.

The mixture has to be sprayed 2 to 3 times during the cropping season like vegetative stage, flowering stage and grain filling stage in the morning hours when sun rises.

All horn manures must not be exposed to sunlight.



VII. LAND DEVELOPMENT ACTIVITIES

AGRO FORESTRY

Agroforestry is one of the soil and moisture conservation practice where forest trees are grown along with agricultural crops. Trees are planted on the bunds of the field for multipurpose utilization. The act as live fencing or wind breakers thus protecting the agricultural crops in the main field. Agro forestry also helps farmers to become self reliant and self sufficient in terms of obtaining daily needs, and stops them from decaying the surrounding forest area.

Ingredients :

Biodegradable bags, varieties of seeds or cuttings, red soil, sand, FYM, pipes for watering

Procedure :

Nursery raising :

To raise nursery sapling, prepare a seed bed or use biodegradable bags (of size 5X8 inches or 8X12 inches or 10X16 inches) filled with mixture of red soil, sand and FYM in the ratio of 1:0.75:1 Sow the seeds or plant the cuttings into these beds / bags to raise the nursery. Watering should be done regularly till the plant attains a height of 1-2 feet.

Transplantation in the main field :

Pits of convenient size (2 feet length X 2 feet breadth X 2 feet depth) is dug maintaining a distance of 10 feet apart between each pit.

Plant the nursery sapling into these pits. See that different varieties of saplings are planted in each

pit to maintain diversity (eg. Fruits/ fodder / manure / medicinal / timber etc). Top soil is added back into the pit as it contains beneficial microorganisms and helps in acclimatization of the environment

Uses of Agro forestry :

The bunds become strong and controls soil erosion. The leaves of the plants or twigs are cut before flowering and incorporated into the main field as manures. Organic carbon and fertility of the soil is increased with increased microbial activity. Simultaneously the biomass content is increased that inturn helps in production of FYM / Compost.

They also help in conserving soil and moisture by reducing runoff, reduce evapotranspiration and harvest moisture from the ground level due to its wider canopy. It also absorbs the leached nutrients from the lower surface of soil and uses it for its growth.

Apart from this, they provide fruits, fodder, green manure, timbre and fibre to the farming family.

The leaves or twigs of these trees are harvested every year and used to incorporate into the soil as green manure crops.

Soil biological properties can be improved. Ecological balance can be maintained in the area.



CONTOUR SOWING

Sowing along the contour / against the slope is contour sowing. This is practiced mainly in dry areas and sloppy land with slope ranging from 5-10 %. This helps to conserve soil and moisture by reducing the soil erosion and increase water holding capacity. The erosion of top soil is reduced by growing the crops against the slope. Addition of manure to the soil is retained due to contour sowing.

Procedure :

In a sloppy area, spots with equal height is demarked with lines and seeds are sowing / seedling are transplanted along the demarked area. Mixed crops of cereals, pulses and trees are planted against the slope to reduce soil erosion. The canopy of trees reduce the rain intensity falling on the ground and inturn make the soil adhere to the roots. Mixing of pulses with cereals not only provide food and nutritional supplement but also makes the soil adhere to the root surface without soil erosion and runoff.



TRENCH - CUM - BUND FORMATION

It is one of the common method of soil and moisture conservation technique constructed in the form of trenches and bunds. This activity is carried out in slopy areas where the slope ranges from 5-10 %. Trenches formed in the sloppy area helps to conserve moisture while bunds obstruct the runoff of soil and rain water.

Procedure :

Select few spots in the entire area with heavy slope. Construct a trench of size 3 mtrs. length X 1.5 mtrs. width X 0.6 mtrs. depth. Trenches are constructed immediately after first rain as it is a feasible period to dig the soil. The soil collected after digging the trench is used to strengthen the bunds that are already formed at the border of the area. It is also feasible to grow grasses like hemata grass or any other grass on the bunds to reduce the intensity of rain directly falling on the bunds.

Rain water gets accumulated in these trenches along with soil and agricultural wastes. After one season of sowing, the entire material from the trench is uploaded and mixed back into the same area to enrich the soil.

Uses :

To reduce soil erosion and increase infiltration.

The water collected in the trenches can also be used to grow agroforestry and kitchen gardens.

This activity also helps to increase the water table of the soil.



BENCH TERRACING

Soil is raised along the slopy area as small plots to form a bench. Benches are formed in slopy land with the slope more than 15 % where there is problem of runoff and soil erosion.

Procedure :

The land is divided into small plots and soil is raised along the slopy area to form benches. The entire area is bifurcated into small plots in the form of benches. At every sloping point, bund is formed as benches to increase water holding capacity and reduce soil erosion. Seeds are sown / seedlings are transplanted into these benches so that soil gets adhered to the roots ultimately reducing soil erosion, absorb moisture effectively and make nutrients available to the plants. By having the raised blocks, water gets collected into this interspace and reduce the run off of soil. The canopy of trees reduce the rain intensity falling on the ground and inturn make the soil adhere to the root surface without soil erosion and runoff.



FARM POND

Pond constructed in the field area to harvest rain water effectively and increase water table is farm pond. These ponds are constructed in the farm where the water gets stagnated due to heavy slope. This method is usually followed for large area about four to six acres where the water from the entire area is collected into this pond.

Procedure :

Select an area where there is heavy slope and water gets stagnated. A farm pond of size 12 / 15 feet length X 12 / 15 feet width X 3 mtrs depth is constructed. Construction of farm pond is undertaken immediately after first rain as the soil is feasible for digging.

The soil collected after digging is again used to strengthen the bunds formed at the border of the field area / farm pond. Forest crops and grasses are grown on these bunds to strengthen the bunds as the intensity of rain do not fall directly on the bunds. Rain water gets collected in these ponds from the entire area. Water collected in this pond is used to raise kitchen gardens, forest crops and other field crops as well.

Rain water gets accumulated in these ponds along with soil and agricultural wastes. After one season of sowing, the entire material from the trench is uploaded and mixed back into the same area to enrich the soil.

Advantages of farm ponds :

Water collected in the farm pond helps to increase the infiltration capacity and ground water table of the area. We can have nursery around the farm pond. The bund constructed around the farm pond can be used to cultivate agro forestry saplings and farm crops.



Fish rearing also can be undertaken in the ponds.

Soil fertility increases by application of sand collected in the farm pond.

The moisture level is maintained uniformly in the entire area where farm ponds are constructed.



CHECK DAMS

Check dams are constructed mainly as a moisture conservation activity. Due to excess soil and moisture runoff, dams are constructed in deep sloppy and stagnating area using stones available on the farm. These are “check dams”. At every slope, these dams are constructed and trees are planted all around to harvest water throughout the year and maintain the stability of the dam. By doing so, it reduces soil erosion where the soil is blocked in that particular dam and only water filtrates through these stones. At the border of these dams, bunding is also done so that green manure crops can be grown effectively over these bunds for agricultural purpose.

Procedure :

Collect moderate to big size stones. Select area where the water is stagnating and arrange these stones one above the other at the border of the sloppy area / water stagnating area to form a dam. Dams using stones are constructed in run off area as catchments.

At every sloppy area these dams are constructed and trees are planted all around these dams. This helps the soil to adhere to the root surface without erosion and simultaneously make availability of moisture to the crops throughout the year. Soil gets adhered in these check dams and only water is filtered through the interspace that are formed between the stones.

Bunding is done at the border of these dams and few green manure crops or kitchen garden crops or other crops are planted over it to reduce soil erosion and simultaneously strengthen the bunds.



Uses :

Water conserved in these check dams are used to feed animals and birds.

It is best utilized to grow forest trees, kitchen garden crops as well as agricultural crops.

Soil that gets collected in these dams is more fertile and hence applied in main agricultural field to enriched soil.

It is also used for aquaculture purpose.

It increases the water table of the area along with increased water level in wells and tube-wells.



VIII. ANIMAL FEED

AZOLLA

Azolla is a minute aquatic plant that can be artificially produced in a small tanks as cattle feed. It is found to be very nutritive and less expensive organic feed supplemented for dairy animals. Azolla is a marshy, free floating aquatic fern that requires standing water for its growth. It is grown in paddy field as it supplies nitrogen to the crop thus reducing use of chemical fertilizers. In recent times azolla is being used by dairy farmers as it has been well established that it is an ideal feed for cattle.

Ingredients :

Cow dung, Azolla, Water, Fertile soil, Polythene cover, Jeevamrutha

Procedure :

A convenient pit size of 3 feet x 5 feet with a depth of 1 foot is dug. To this pit a polythene cover of the same size is spread below and 4-5 inches of water is added. Dung and jeevamrutha are mixed well and added to this pit. Fertile soil is added to this pit and azolla is allowed to grow in this pit. The pit is shaded, since azolla does not grow well under sunlight. Every week jeevamrutha is added for healthy growth of azolla. Water has to be changed at regular intervals of 15 days and fresh cowdung and jeevamrutha is added. Similarly fresh fertile soil and cowdung should be added for healthy growth of azolla. By doing so every day 100 grams of azolla could be harvested.



Usage :

After harvesting, this feed should be washed in clean water to avoid dust and smell of dung and fed to animals along with hay or husk (hindi).

The Azolla feed helps the cattle to be healthy and the milk yield increases considerably.

Azolla supplies high quantity of oxygen if administered to the paddy crop grown by SRI method or traditional farmers method which supports good paddy yield.



SILAGE PREPARATION

(JUICY CATTLE FEED)

Green fodder is considered as one of the best foods for the cattle. But it is difficult to provide green fodder for the cattle through out the year and in all seasons and in all places, except in irrigated lands. Preserving green fodder without any loss of nutrient content is known as 'Silage'.

Silage is a cattle feed in its green succulent form. This would help the farmers to feed their cattle throughout the year. Silage is a method to preserve fodder, when green fodder is found in abundance. This method is useful to provide fodder during lean periods. Silage is preserved in an anaerobic (without air) environment with a pH of 3.6 to 5.0. Silage is made by fermentation at moisture level. Fodder is preserved without any loss of nutrients though it loses its original colour. Good silage has a fruity odour and is golden yellow in colour. The fodder preserved in this method is much more tastier and most liked by the cattle and is easily digestible. Providing green fodder to the cattle can decrease the intake of husk and other feeds.

Ingredients :

Small pieces of green fodder like jowar, maize, millets etc., jaggery, salt, mineral mixture, water, vessel, sieve

Procedure :

Collect 25 litres water in a vessel and mix 2 kgs. jaggery, 2 kgs. salt, 1 kg. mineral mixture into it to prepare a solution.



A tank of convenient size (5 feet length, 5 feet breadth and 5 feet depth) is constructed either above the ground or below with cement lining. Green fodder collected from the field (jowar fodder) is chopped and filled into this pit to a height of ½ feet and pressed properly to avoid air space. With the help of sieve, the solution prepared by jaggery-salt-mineral mixture is spread evenly in the tank. This method of adding green fodder and the solution layer by layer is repeated till the material reaches the brim of the tank. Press the entire materials in the tank and cover it with dry grass. Cover the tank with thick layer of cowdung and finally plaster it with soil to create anaerobic condition and simultaneously avoid evaporation of moisture and nutrients. This is allowed to ferment for 45 days. So obtained silage is obtained in green succulent form without any loss of nutrients and used to feed cattle during lean period.



HAY PREPARATION

A forage plant when preserved through reducing the moisture content to the level at which plant tissues are dead or dormant is termed as hay. The hay depends on various ways of processing. To have the best advantages, Sun drying is one such method to conserve hay.

Ingredients :

Dry fodder, a clean place for storage

Procedure :

Collect dry forage after harvesting the yield. Select and clean the area for storing the fodder. Care should be taken to heap the fodder away from humid condition or during rainy season. Naturally sun drying method is followed to convert fodder into hay.

Sun drying method :

The harvested forage can be processed using four different ways of sun drying methods to reduce the moisture content for a safe level preservation.

a) Ground method: the fodder after harvesting is left on the field till it dries. Frequent turning is needed during early phase of drying.

b) Vertical method: Sorghum and Maize fodder are kept vertically in the field in the shape of cone. This method is practiced in the

c) Farm fencing method: Grass after harvesting is spread over barbed wire fencing or on a boundary wall of the farm. It is tilted twice for proper storing.



d) Cubical drying method: Farmers in the silk producing area use wooden or iron structures (refer photograph) to which grass bundles are spread over on the wooden/iron cubical structure using bamboos. Grass is occasionally tilted for proper drying. Advantages being Increasing the total area of exposure to sun accelerates the drying action and the loss of nutrients is less due to quick drying and best method for hay making particularly in bad weather.

Advantages in ground method are there is no excess cost involvement in preservation except a small expenditure incurred on the labourers. This method doesn't need any structures and is convenient as the hay is prepared at the site of production thereby reducing the cost of transportation. But disadvantages are that hay preparation should not be undertaken either during humid conditions or in rainy season due to excess loss of nutrient. So obtained hay is chopped and fed to animals as feed.



BANAVE

(FODDER STORAGE TECHNIQUE)

There are various methods of storing fodder to feed the cattle during off season. One such form is “Banave”.

Procedure :

Banave model is advantageous over other methods in such that the livestock gets the complete nutrition from the feed. It is stored in the combination of different dry fodders by placing dry fodder layer by layer in a heap with combination of cereals and pulses. Initially one layer of paddy straw is spread over which horsegram straw is layered. Again ragi straw is put as third layer over which lablab straw is heaped.

Again paddy straw is added over which redgram straw is heaped and finally covered with ragi straw all around. Such Banave provides the complete nutrition required by a livestock.

This can be stored for 4-6 months.

At the bottom of this Banave, an opening is made to take out this feed whenever needed.

