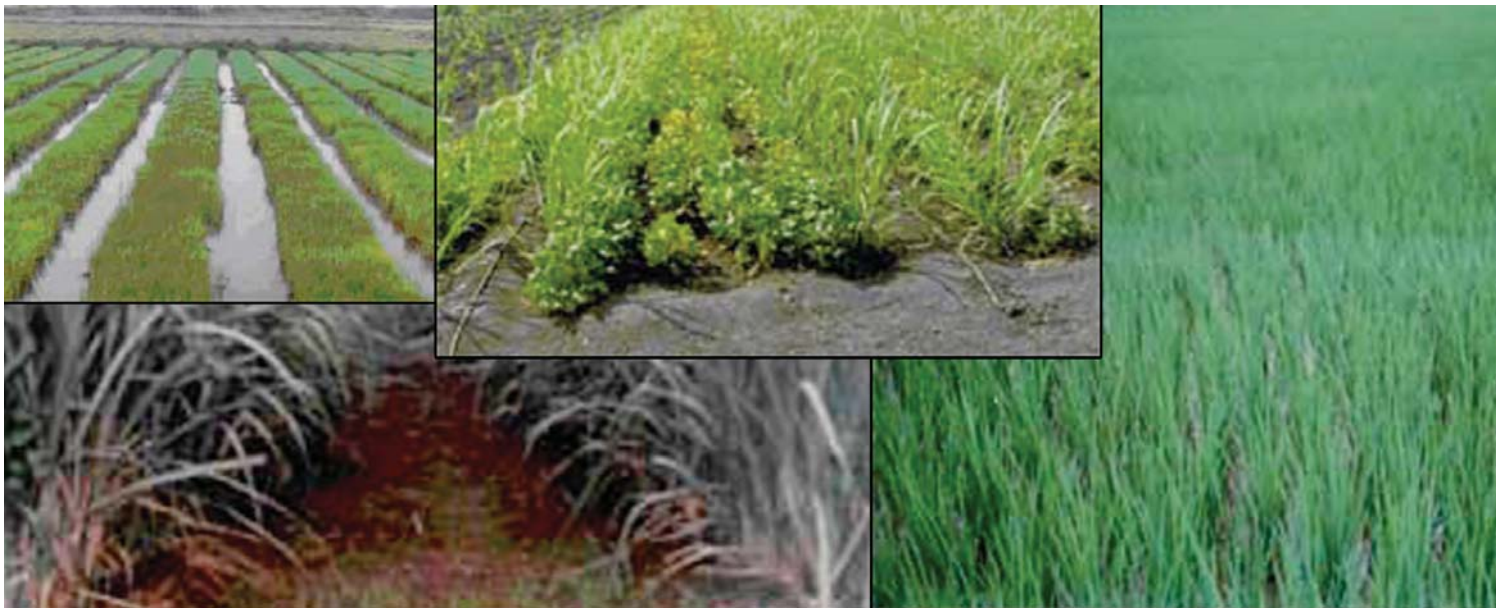
# Package of Organic Practices from Maharashtra

*for*

**Cotton, Rice, Red gram, Sugarcane and Wheat**



Maharashtra Organic Farming Federation (MOFF)

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*Prepared by*
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*Prepared by Maharashtra Organic Farming Federation (MOFF)*
(June 2006)

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Disclaimer:

*The accuracy of the facts and reporting on which the present study is based is the responsibility of the author/institution alone and not of the FAO or the Ministry of Agriculture, Government of India. However, every care has been taken by the authors to ensure adequate verification.*

For copies of this report, please write to:

MOFF
(*See address above*)

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www.fao.org.in

# Acknowledgements

The Maharashtra Organic Farming Federation (MOFF) is a voluntary organization of farmers from across the state who have joined together to protect and improve the economy of organic farms, the environment and the health of the consumer. Organic farmers' choices today vary from natural farming (low intervention type) to farm methods using several external inputs. However, their objective is the same – reduce farming costs, earn sufficient income and ensure that the producer and consumer of food can both lead healthy lives. Keeping this purpose in mind, MOFF members have first tried and tested, and later standardized, a set of 'best practice' techniques that farmers may vary and adapt, depending on the agro-climate of the region or farm ecology. This method of working provides farmers with a variety of practices to choose from, as per their local needs.

MOFF is grateful to its leading members (listed below) for having documented these diverse practices systematically and for having compiled them into crop-wise packages, for the convenience of ordinary farmers.

| | |
|---|---|
| Cotton: | Ms. Chandraprabha Bokey, Adv. Manohar Parchure |
| Rice: | Mr. Jaywant Wadekar, Mr.Sanjay Patil |
| Red gram: | Ms. Chandraprabha Bokey, Mr. Diliprao Deshmukh |
| Sugarcane: | Mr. Ashish Wele, Mr. Shivraj Ingole, Mr. Suresh Desai |
| Wheat: | Mr. Madhukar Barve, Mr. Padmakar Chinchole, Mr. Ashok Bari |

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| | |
|---|---|
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| Rice: | Mahatma Phule Krishi Vidyapeeth (Agricultural University) Research Station at Karjat, District Thane. |
| Red gram: | MPKV Research Station at Badnapur, District Jalna. |
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Vikram Bokey
President

# Preface

Organic farms are mushrooming all over the country, largely due to the desire to get premium prices in the urban and export markets. Organic farming products need to be certified, which in turn demands rigorous documentation and costly inspection by consultants and, sometimes, expensive laboratory testing as well. MOFF, however, is promoting organic farming as a low-cost, expenditure-saving approach to food production and secure livelihoods for small and marginal farmers who can earn more and save more through its methods.

MOFF believes in Low External Input Sustainable Agriculture (LEISA) principles, which basically emphasize that farm nutrition can be managed well by recycling the farm's biomass. This is done through (a) crop rotation; (b) green manure crops, intercrops, and weed mulching; (c) cow dung and cow urine based preparations that act as both nutrients and disinfectants. Emphasis is always on decentralized mulching, i.e., *in situ* composting rather than on constructing costly vermicomposting sheds or tanks.

A fertile soil will result in healthy crops that need little or no pest control measures. However, if intercrops and trap crops in the system cannot reduce pest attacks, herbal pest repellants such as *neem* seed or leaf extract or *dashaparni* may need to be sprayed in the initial years till the ecosystem regains its health.

Market-purchased microbial inputs such as biopesticides and biofertilizers, as well as tricho-cards, etc., may be needed only in the first or second years – after conversion – in order to revive the microbial farm population which may have been obliterated due to the extensive use of chemicals during the past few decades. It may not be necessary to purchase such inputs in the subsequent years.

Seeds used on organic farms should be traditional varieties or improved/selected varieties. In the latter case, the cost is low in the first year and nil thereafter, as the seeds that are saved regenerate on being replanted. Their productivity may appear a little less when compared with the output of hybrid seeds. However, plants grown from hybrid seeds suffer from heavy insect attacks and moreover, require assured and intensive irrigation. Thus, in the long run, they prove to be uneconomical.

# ORGANIC INPUTS

This chapter outlines various inputs for nutrient, pest and disease management commonly used in the organic farming of crops. The method of preparation and application is briefly described. For more detailed information, please consult the companion FAO publication, *Current State of Inputs for Organic Agriculture*.

## SOIL NUTRIENTS

Nutrients for organic farming can be managed in a number of ways in an integrated manner. Composting is the most important and widely used option. Various other methods include the use of green manure crops, crop rotations, crop residue, mulching and biofertilisers.

## COMPOSTING

Composting is a process by which organic wastes are converted into organic fertiliser by means of biological activity under controlled conditions.

- Land selection for compost making
- The land selected should not be low-lying or waterlogged.
- Upland or an elevated land that has shade is ideal for compost preparation.
- The soil should not be sandy.
- The soil in which compost is to be prepared should not be penetrated by roots of trees.
- Materials to be avoided: Plastic products, polythene covers, bones of cattle, stones, thick stems of plants and glass bottle pieces.

### Different types of compost

There are various popular methods of composting and notable amongst these are the following:

- Aerobic composting
- NADEP composting
- Cycle method of composting

- Vermicomposting
- Biodynamic composting

### Aerobic composting

Usually compost is best made by spreading the biomass in layers using alternative layers of material rich in nitrogen – for example, fresh green grass, leaves and shoots of leguminous trees such as subabul (*Leucaena leucocephala*), *glyricidia* (*Glyricidia maculeata*), *daincha* (*Sesbania aculiata*), sunhemp (*Crotolaria juncea*) etc.) and carbon – for example, paddy straw, hay, wood chips, dry leaves, grasses, coir pith, coconut fronds etc. In this way, the green material provides the nitrogen that the bacteria requires for their growth in order to break down the carbon material. A general recommendation is to make every layer of nitrogen rich materials six inches high and of carbon rich materials, four inches high. Besides maintaining a balanced proportion of 60 and 40 percent respectively, layering also improves air circulation within the heap. If animal dung is in short supply, it can be made into a slurry and sprinkled on each layer of carbonaceous material to work as a starter mixture. Care must be taken to keep the dry carbon material moist. Generally, it is advisable to wet the dry materials before they are added to the heap. A simple test to assess proper moisture content is that no water should drip out of the material when it is squeezed by the hand.

### NADEP composting

A brick structure measuring 10' x 6' x 3' is prepared – with holes in the side walls to ensure adequate supply of air during composting. The brick tank is filled with farm wastes, soil and cow dung and water is added to maintain moisture between 60–75%. A tank is filled with soil (16–18 qtls), farm wastes (14–16 qtls) and cow dung (1–1.2 qtls). Water is added to moisten the material and the upper layer is plastered with the soil and dung

mixture. After 75–90 days of composting, a microbial culture of azotobacter, *rhizobium* and phosphate solubilizing bacteria is added to the mixture.

Compost becomes ready for use within 110–120 days. One tank provides about 2.5–2.7 tonnes of compost sufficient for one hectare of land.

### Cycle method of composting

This method of composting requires three pits of 1 x 1 x 1 m length, breadth and height with a spacing of 0.3 m in between them.

Fill the first pit with all kinds of kitchen waste, farm waste, litter and cow dung. A few days later, transfer the decayed contents from the first pit to the second pit. Now, the first pit should be filled with fresh waste. When this gets decayed, the contents in the second pit should be shifted to the third pit and the second pit should be filled with the contents of the first pit. This process should be continued till the third pit gets completely filled. The compost in the third pit can be used ten days after it is filled.

### Vermicomposting

Vermicomposting is a method of converting wastes into compost through the use of earthworms. The compost produced by this method is superior to other composts. Depending upon the number of earthworms used, the time required for composting can also be considerably reduced. Large quantities of waste can be composted by this method – i.e., about 4–5 kg of wastes can be composted by 1000 worms (approximately 1 kg) in a day. The commonly used earthworms are *Eudrillus sp. Perionyx sp.*, *Eisenia sp.* Any locally available surface feeding (*epigeic*) earthworms can also be collected from the nearby soil and used for the purpose.

For setting up a compost pit, dig a pit of size 2 m x 1 m x 1m – the length and breadth can be adjusted according to the

requirement. Fill the basal 0.15 m of the vermibed with broken bricks or pebbles. This is to avoid excessive water logging in the pit. Follow this with a layer of coarse sand to a thickness of 0.05 m to ensure proper drainage. This is followed by a 0.15 m moist layer of loamy soil. Into this soil, inoculate about 3000 locally collected earthworms. Scatter small lumps of cattle dung (fresh or dry) over the soil. The dung serves as food for the worms in their early stages. Cover this with dried leaves or hay up to 0.05 m. Sprinkle water and keep the entire setup moist. Keep the unit covered with coconut fronds. Spread organic refuse from the thirty-first day on the bed after removing the fronds. The spread should not exceed 0.05 m in thickness for each application. This can be done twice a week. After a few applications, turn over the refuse without disturbing the bed. When enough refuse has been added into the unit, keep it moist and 45 days later the compost is ready for harvest.

The base of the tank should have a slight slope directed towards two drainage holes. Composting can be done in pits, concrete tanks, well rings, wooden or plastic crates appropriate for a given situation. In places where worm predators like rats, lizards, pigs are a major problem, the tanks should be covered with wire mesh to protect the worms.

### Vermiwash

Vermiwash is made from earthworms reared in earthen pots or plastic drums. Secretions from the ducts of earthworms are a rich source of nutrients, vitamins, gibberellins, etc. In a big earthen pot or plastic drum (200 lit.) make a tiny hole and place a layer (5 cm) each of small stones and red sand at the bottom for effective drainage. Fill the container with 30–40 cm layer of kitchen waste or one week old dung and release 200–300 earthworms into the pot. After two weeks of earthworm inoculation, arrange water to be poured into the pot in such a manner that it drips out from the

bottom in the form of drops. This extract is called vermiwash and it is generally used as a foliar spray, after dilution with water in a 1 : 5 ratio.

**Biodynamic composting:** Biodynamic (BD) composting is a very unique method of converting wastes into a humus-like mass. This method comprises the use of special herbal homeopathic preparations (BD preps 502–506). These preparations enhance the composting process and in turn enrich it with nutrients. The composting period may vary from three to four months. BD preps are made and marketed by several companies in the country and together with the preps, detailed instructions are provided for their use in composting and other farm operations. More details on BD composting are available in the *Current State of Inputs for Organic Agriculture.*.

**Compost enrichment** It is a common practice to add minerals and microorganisms during the composting process, depending on the need. For enriching compost with phosphorous, use of rock phosphate is recommended. For calcium, lime is added. These are mixed with soil, FYM and cow dung slurry in water and spread over layers while preparing the heap for composting. Use of phosphate solubilising microorganisms (PSM) is highly beneficial at the time of composting. Other ingredients that could be added to compost heaps are non-edible oil cakes. They can be used directly as manure or incorporated in the composting process so that they are well mixed and the enriched compost is available to meet the nutrient requirement of the crops.

**Mulching** Mulching is one of the simplest and most beneficial practices that can be used in organic farming. Mulch is simply a protective layer of a material that is spread on the top of the soil. It could comprise of grass clippings, wheat or paddy straw, rice husk, saw dust, coir pith, banana leaves or any other crop residues. Mulching

increases infiltration of water, improves soil and moisture conservation, regulates and moderates soil temperature, improves root growth and over time, enhances the water holding capacity of the soil and enriches it with organic matter. General guidelines are that weeds should be first uprooted from the soil (if they have no seeds or vegetative propagating parts, they should be used for mulching too) and that the soil should be moist at the time of spreading the mulch.

### Green manuring

A variety of crops are used by farmers in different regions for the purpose of green manuring. In this practice, farmers sow a crop and allow it to grow to a certain stage before they plough it back into the field. Preferably, the time gap between ploughing the green manure and sowing the next crop should not be longer than 2–3 weeks so as to prevent nutrient losses from the decomposing green manure. This procedure increases the nutrient content of the soil while ensuring control of weeds. Common crops used for green manuring are sunhemp (*Crotolaria juncea*), *daincha* (*Sesbania aculeata*), horse gram (*Dolichos biflorus*), green gram (*Vinga radiata*), cowpea (*Vinga anguiculata*), black gram (*Vinga mungo*), cluster bean (*Cyamopsis tetragonaloba*), berseem (*Trifolium alexandrium*), pea (*Pisum sativum*), moth bean (*Vinga aconitifolia*), lupin (*Lupinus sativus*), *glyricidia sp.*, etc. In general, these incorporate 8–30 tonnes of biomass and 38–135 kg N/ha. In many places, application of thick green leaves is also a practice under green manuring. The leaves of mango, jackfruit, cashew, etc. are preferred as they have long lasting residual effects.

## BIOFERTILISERS

The use of biological nitrogen fixation and phosphorous solubilising/mobilising microorganisms is found extremely effective in organic farming. Commonly used organisms are:

- *Rhizobium* – Recommended for leguminous pulses and oilseed
- Azotobacter and azospirillum – Recommended for cereals, vegetables, etc.
- Blue green algae and azolla – Recommended for rice
- Phosphorous solubiliser (bacillus, pseudomonas)

### Azospirillum

Azospirillum is a type of bacteria that grows around the roots of cereal plants and grasses. It is capable of absorbing atmospheric nitrogen and converting it into a form that can be utilised by plants. Since it grows in the root regions, it helps the plant to absorb the nitrogen from the soil. It works effectively in those soils where the phosphorus content is less. Studies indicate that azospirillum can fix 50–200 gm of nitrogen per day in paddy.

#### Advantages of using azospirillum

Azospirillum fixes atmospheric nitrogen in the root regions of crops thereby enabling its easy assimilation. This enables the plant to grow well. The cost of adding nitrogen fertilisers for one acre of land is reduced by 10%. Azospirillum produces plant growth hormones in the root region thereby increasing plant growth, the number of tillers, grains and straw yield.

### Azotobacter

Azotobacter is a kind of bacteria that grows around the roots of the plants and utilizes the carbon present in the soil. It is also capable of absorbing atmospheric nitrogen and converting it into a form that can be utilised by the plants. The bacterium is affected by high acidity, high salt content and high temperature. It grows well in waterlogged paddy fields.

**Phosphobacteria**

This is a type of bacteria that is capable of growing around the root surface of the plant. The growth of the microorganism helps in conversion of insoluble phosphate (a source of phosphorus) into a soluble form. Thus it aids in the absorption of phosphorus by plants.

**Method of application**

For every hectare of crop, two kilo of azospirillum or azotobacter and two kilo of phosphobacteria should be mixed with 25 kg of well-decayed manure or wet sand and applied before transplanting. This helps to increase the population of these microorganisms in the soil.

**Advantages of using phosphobacteria**

Phosphobacteria convert insoluble phosphates into a soluble form that can be absorbed by plants.

- Yield of plants is increased by 10–20% in all crops.
- The bacteria help in the flowering and development of earheads and roots.
- They also help in nitrogen fixation.

**Algae**

Growing algae along with paddy supplies the crop with the required nitrogen and phosphorus. Azolla or blue green algae should be strewn in the field 5–10 days after transplantation of paddy. The field should be drained twenty-five days and 45–50 days after strewing and the algae should be stamped into the soil.

**Azolla**

A floating fern that grows in the stagnant water of rice fields. This plant hosts algae called *anabaena azollae* in the cavities of its tiny fronds. It provides the necessary nutrients and space required for the growth of these algae. In turn, the algae provide the azolla fern with fixed atmospheric nitrogen and other nutrients essential for its growth. Azolla grows well in marshy land where paddy is cultivated. It is capable of providing 40–60 kg of nitrogen per ha.

### Method of application

Five to seven kilos of azolla are required per hectare of land. First, the water should be allowed to stagnate in the land that is to be cultivated. Then azolla should be sown. After one week, these plants are stamped into the soil before transplanting is done. It degrades in about 7–10 days and thereby provides nitrogen to the rice crop.

### Growing azolla along with paddy

After ten days of planting, azolla should be strewn in the rice fields. It grows along with rice as an intercrop. It grows well in about 25 days and spreads uniformly over the field. Then the water in the field is allowed to drain and azolla is stamped beneath the soil. Once again, azolla resumes profuse growth. This is again stamped at the time of the second weeding. Burying azolla beneath the soil once helps in fixing 15–20 kg of nitrogen.

### Advantages of using azolla

- It provides nitrogen to the crops.
- By growing it along with the paddy crop, weeds can be eliminated.
- Use of azolla as a green manure is equivalent to the use of ammonium sulphate fertiliser.

## Blue green algae

BGA are a type of photosynthetic cyanobacteria that belong to the plant kingdom. They are found in paddy fields where good sunlight, water, high temperature and high nutrients are found. They fix atmospheric nitrogen and can be seen floating as dense mats in a filamentous form on the water surface in paddy fields. BGA grows well in clayey and alluvial soil.

### Method of application

BGA are added to the soil within ten days of transplanting at the rate of 10 kg/ha. They are available as small bits in plastic packets.

This should be powdered and directly added to the soil. Water should be allowed to stagnate to a depth of 3–5 cms in fields where algae are grown.

Blue green algae should be added to the field continuously for four cropping seasons. Thereafter, it grows naturally in the soil and produces the desired results.

### Advantages of using blue green algae

- Crops obtain 60% nitrogen content by the use of blue green algae.
- The algal filaments decompose in the fields and increase the humus content of the soil.
- BGA dissolve phosphorus and make it available to the crop.
- They also dissolve iron and sulphur salts stagnating in the soil, thereby increasing soil fertility.
- BGA also enhances the chemical properties of the soil.
- Plant growth hormones produced by BGA increase plant growth.

## PROBLEM INSECTS AND DISEASE

A number of options such as crop rotation, summer ploughing, solarisation, inclusion of cover, companion, inter, green manure, trap crops, use of local seeds/varieties, pheromone traps, predators, parasites, botanicals, biopesticides are available for need based management of pests and plant disease.

### Cultural methods

Adjust the time of sowing to modulate growth of the crop. Plant to plant and row-to-row spacing is similarly used to alter the microclimate and reduce risks. There are no standard prescriptions for these and are generally based on the knowledge and experience of the farming community.

### Crop rotation

Rotating the crop belonging to one family with one of a different family helps to reduce pests and weed to a large extent.

**Trap crops**

Pests are strongly attracted by certain plants and when these are sown in a field or along the border, tend to gather in them, enabling their easy collection and destruction. African marigold, mustard, maize, etc., can be grown as trap crops in cole crops, cotton and vegetables.

**Intercropping**

Inter cropping generally has a positive effect in terms of reducing the occurrence of pests. Insects find it difficult to locate host plants as the visual and chemical stimuli from the hosts are not strong and the aromatic odour of other plants can disrupt host finding behavior.

**Use of resistant/tolerant varieties**

Genotypes showing tolerance or resistance to pest and disease are preferred in organic cultivation. A series of resistant varieties of different crops have been developed in recent years for most climatic conditions.

**Summer ploughing**

Summer ploughing is an important cultural practice for pest control. When the land is ploughed, the inactive stages of pests like egg masses, larvae and pupae present within 5–10 cms surface of the soil get exposed. They are killed due to the intense heat of summer and are also eaten away by predatory birds.

**Keeping bunds clean**

Field and field bunds are the favourite egg laying spots of most pests. Hence, wild grasses and weeds found in the field and on the bunds should be periodically removed.

**Plastering of bunds**

Weeds found on the bunds should be removed and the bunds should be plastered. By doing this, rat holes found near the bunds can be sealed and rodent damage controlled. Such a procedure also prevents water leakage.

**Proper spacing among the seedlings**

When paddy seedlings are transplanted to the main field, they should be laid out at proper spacing. For short duration varieties, the inter row spacing should be 5 cm and inter hill spacing should

be 10 cm. For medium duration varieties, it should be 20 cm x 10 cm and for long duration varieties, 20 cm x 15 cm. This facilitates penetration of sunlight to the lower portions of the crop and thus prevents pest and disease incidence.

**Providing sufficient gaps**

While planting seedlings, a one-foot gap should be provided after every eight feet to enable sunlight to reach the lower segments of the plants. This reduces the incidence of pests that are found on the under surface of the crop. Such spacing also helps during the application of manures and the spraying of biopesticides.

**Yellow sticky traps**

An empty tin or a plate painted yellow and smeared with castor oil should be placed one foot above the crop canopy in the field. The adults of sucking pests that are attracted by the bright yellow colour get trapped in the oil smear. These pests should be wiped out every day and oil should be applied afresh.

*Yellow sticky trap*

**Light traps**

Light traps can be used to monitor and trap adult insects, thereby reducing their population. Some formal light traps that could be used are electric bulbs, hurricane lamps and bonfires. Water mixed with kerosene is filled in a large plate or vessel and kept near the light. The trap should be fixed 2–3 ft above the crop canopy and

set up in the field between 6 and 9 pm. (If it is kept beyond 9 pm, there are chances that the beneficial insects will also get trapped and killed.) The adult moths, which get attracted by the bright light, fall into the water in the vessel and perish.

*Light trap*

### Pheromone traps

About eight traps should be used per hectare. They should be placed two feet above the crop canopy. The level of the trap should be adjusted according to the plant height (1–2 feet above). A chemical called a 'pheromone' – obtained from female moths – is used in the pheromone trap to attract male moths. The latter are pulled into the trap by the pheromone and die.

### Bird perches

'T' shaped bird perches should be erected in the field at the rate of 15–20 per hectare. They should be placed one foot above the crop canopy. These perches serve as resting places for the birds which feast on the larvae they find in the field.

Mix rice with the blood of a chicken, make it into pellets and broadcast these in the field. The smell of blood and rice attracts predatory birds to the perches in the field from where they pick up the swarming caterpillars.

### Use of effigies

A human-like figure, made of paddy straw and wearing a white dress (@ two effigies per hectare) kept in the field at milky to grain-filling stage, will scare away the birds.

### Fumigation for disease control

Diseased crops can be sprayed with 10% cow urine solution. On the same day or the following day, fumigation should be carried out in the evening. About 200 gm of *vaividanga* (*Embelia ribes*) or sweet flag (*Acorus calamus*) is powdered well, put in a wide mouthed pot with burning charcoal and carried into the field in a direction opposite to the wind. On the seventh day after fumigation, sweet flag rhizome extract should be sprayed. This method controls bacterial and fungal diseases.

*Perch with yellow coloured rice to attract birds*

## BIOLOGICAL METHODS

### Use of plants with pest repellent properties

Leaves of neem, vitex, morinda, calotropis and jatropha are used for this purpose. Any two of the above mentioned leaves are taken and pounded well. The pounded leaves are put into mud pots and thrice the quantity of water added to them. The mouths of the pot are tied with a cloth and the pots as such are left aside for three days. The pots are then placed in all the four corners of the field. In the evening hours, the mouths of the pots are opened and the contents stirred well.

The unpleasant odour which emanates from them will inhibit the entry of pests into the field.

**Neem cake for pest control and manuring**

Gunny bags filled with neem cake should be placed along the water channels. The neem cake gets dissolved in the water which irrigates the field. This practice prevents attacks from pests and diseases that affect the roots and tillers of the crop. The bags should be replaced once every 15 days.

**Use of Cycas flowers**

The flower of Cycas (*sannampu*) are cut into pieces, wrapped in straw and placed in the field @ 25–30 pieces /hectare. The odour that is emitted from this flower prevents the entry of earhead bugs for two weeks. By this time, the milky stage is over and the grain matures without any interruption.

**Preparation of botanicals**

**Neem-based products**

Neem has been used from time immemorial as a bio pesticide. Various parts of the neem tree are used today in the making of botanical preparations.

**Neem seed kernel extract**

Good quality neem seed should be collected and pounded to remove its outer seed coat. It is next immersed in water (50 gm of kernel in one litre of water). After 12 hours, the solution should be filtered through a fine cloth and made up to one litre with the addition of water. The result can be used for direct spraying. About 350–450 litres of the solution are required for one hectare. Khadi soap solution @10 ml/litre (100 ml/tank) should be added as an emulsifier to help the spraying of solution in a uniform manner. The concentration of the extract can be increased or decreased depending on the intensity of the pest attack. The extract can be stored for a month.

The seeds used for preparing the extract should be at least three months old. When they are less than three months old or

more than eight months old, their azadirachtin content will be less and the extract would be less potent and effective. The extract prepared should be milky white in colour. If it is prepared from aged seeds, the extract will be brownish in colour. NSKE is effective for a variety of leaf eating insects and can also be undertaken as a prophylactic measure.

### Neem leaf extract

One kilo of neem leaves is crushed and soaked over night in five litres of water. Before spraying, the solution is strained and one ml of soft soap solution is mixed per litre of extract. This solution is effective as a foliar spray against sucking and chewing insects. It can also be applied directly to the soil to control nematodes, especially in *solanaceous* crops. If the concentration of the solution is to be doubled, 2–2.5 litres of crushed leaves per litre of solution will have to be crushed and soaked.

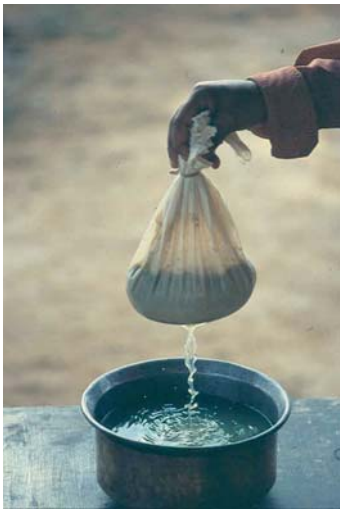
### Neem cake extract

100 gm of deoiled neem cake is taken to make each litre of aqueous solution. The cake should be kept in a cloth bag and hot water poured over it. The solution should be kept overnight in a covered container. This extract is very effective against all stem boring insects.

### Neem oil

About 25 to 30 ml of neem oil is mixed with soap water to make an emulsion that can be sprayed for the control of fungal disease such as downy mildew. Neem oil solution is also effective against a wide range of pests such as beetles, plant hoppers, caterpillars, etc., but it can also harm some beneficial insects. Neem oil is mainly used to protect seeds during storage. About 5–10 ml of oil is mixed well with 500 ml of seed, before placing them in airtight containers.

*Ginger, garlic, chili extract*



*Ginger, garlic, chili extract preparation*

### Ginger, garlic, chili extract

For preparing an extract required for one hectare, 2.5 kg of garlic, 1.25 kg of ginger and 1.25 kg of green chili are first ground into a fine paste which is then diluted in about 18 litres of water and filtered. The concentration of the extract can be increased or decreased depending on the intensity of pest attack. It should be used immediately after preparation and can be stored for a maximum of three days.

### Five leaf extract

This extract is prepared using the leaves of five different plants. Leaves with the characteristics described below can be used for the purpose:

- Plants with milky latex – e.g., *calotropis*, *nerium*, cactus and jatropha.
- Plants which are bitter – e.g., neem, andrographis, tinospora and leucas.
- Plants that are generally avoided by cattle – e.g., *adhatoda*, *Ipomea fistulosa*.
- Aromatic plants – e.g., *vitex, ocimum*.
- Plants that are not affected by pests and diseases – e.g., morinda, *Ipomea fistulosa*.

Any five of the above mentioned plant leaves should be collected in equal quantities (1 kg of each) and pounded well. Transfer this to a mud pot and add two times (10 litres) the quantity of water. To this, add one litre of cow urine and 100 gm of asafoetida. Tie the mouth of the pot tightly with a cloth. The extract should be mixed well daily every evening and used after a week after filtration. Cow urine is used for disease control and asafoetida prevents flower dropping, enhancing the yield.

### Jatropha leaf extract

Collect 12.5 kg of jatropha leaves, pound and place in a mud pot. To this, add 12.5 litres of water and allow to ferment for 3–7 days. Filter and use the extract for spraying (after diluting with 10 parts of water) for one hectare area.

### Sweet flag rhizome extract

Pound 10 gm of sweet flag rhizome to a coarse powder and add 50 ml of water. Leave the solution undisturbed for one hour and filter the sweet flag rhizome extract. For seed treatment, boil one litre of water and add 50 ml each of cow urine and sweet flag rhizome extract the following day. Soak the seeds in water for six hours and then in the above solution for about 30 minutes. Filter the seeds, shade dry and sow. This procedure protects the seed against a number of bacterial and fungal diseases.

### Turmeric rhizome extract

Shred one kilo of turmeric rhizomes. To this, add four litres of cow urine, mix well and filter. Dilute with 15–20 litres of water. For every litre of the mixture, add 4 ml of khadi soap solution. This helps the extract stick well to the surface of the plant.

### Cow dung extract

Mix one kilo of cow dung with ten litres of water and filter using a gunny cloth. Dilute the solution with five litres of water and filter again. The result can be used for spraying.

### Andrographis or *Sida kashayam*

Collect *Andrographis paniculata* or *sida acuta* leaves and wash first with tap water. Cut the materials into small pieces. Take a wide mouthed brass vessel, transfer the cut leaves to this vessel and add four parts (four times the quantity of leaves) of water. Boil them on a low flame until the contents are reduced to one-fourth the original volume (approximate time of boiling to get 500

ml of *kashayam* will be about two hours and 30 minutes). Pour the solution into a glass jar and allow it to cool for half an hour. After cooling, filter the solution using a khada cloth and add 1% sodium benzoate solution as preservative.

About 500 ml of this solution is mixed with 100 ml of khadi soap solution and diluted in 9.4 litres of water for field spraying.

### Eucalyptus or lantana leaf extract

Boil tender leaves of eucalyptus or lantana (1 kg in 1.5 litres of water). Cool the solution, filter the next day and dilute with 20 litres of water. About 350–450 litres of this solution can be used directly for spraying in a one hectare field area

## Indigenous innovations in microbial nutrients

### *Panchagavya*

*Panchagavya* is a growth regulator produced from a combination of five products obtained from the cow along with a few other bioproducts. Collect fresh cow dung (5 kg), mix it with ghee (1 litre) and keep it in a plastic barrel separately for three days. On the same day, mix the other ingredients, namely cow urine (three litres), cow's milk (two litres), curd (two litres), yellow banana (400 gm, without skin), coconut water (three litres), jaggery (one kilo dissolved in three litres water) in a plastic barrel separately. Filter the jaggery solution before adding it to the other ingredients. On the third day, mix the contents of both the barrels and leave them aside for seven days. Stir the contents with a wooden stick twice a day. After seven days, filter the product with a khada or terracot (TC) cloth and store it in closed containers. (Pierce small holes in the cap of the containers to prevent bursting.) This is diluted @ 300 ml/10 litres water and sprayed.

### *Amirthakaraisal*

Take fresh cow dung (10 kg), cow's urine (10 litres), country jaggery (1 kg) and water (100 litres) in a cement tank and mix well. This can be used the following day. Add this extract to the irrigation channel or spray directly.

This improves the soil fertility and gives good yield.

***Beejamrut***

*Ingredients*

| | |
|---|---|
| Cow dung | 5 kg |
| Cow urine | 5 lit |
| Cow milk | 1 lit |
| Lime | 250 gm |
| Water | 100 lit |

Mix all the ingredients and keep overnight. Sprinkle the formulation on seeds to be sown, then dry in the shade before sowing.

***Jeevamrut***

*Ingredients*

| | |
|---|---|
| Cow dung | 10 kg |
| Cow urine | 10 lit |
| Jaggery (old) | 2 kg |
| Flour of gram, pigeon pea, *moong* or cowpea or urid | 2 kg |
| Live soil | 1 kg |
| Water | 200 lit |

Take 100 litres water in barrel and add 10 kg cow dung + 10 litres cow urine. Mix well with the help of a wooden stick, add 2 kg old jaggery and 2 kg flour. Mix this solution well with a wooden stick. Keep the solution aside for fermentation for two to seven days. Shake the solution regularly three times a day.

***Amrut pani***

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

## BIOCONTROL METHODS

In this method, insects are used to control plant pests. Natural enemies of insect pests, also known as biological control agents,

include parasites, predators, fungi, bacteria, viruses and other living agents. These seek out and kill target insects that have become pests. They may be natural or genetically improved organisms.

**Parasites**

Parasites are organisms that live in or on the body of their host during some part of their life cycles. They are mostly flies or wasps that generally complete their development on a single host. Parasitic insects are responsible for controlling a number of pests. These beneficial insects either predate the pests or damage the different stages of insect development like egg, larva and pupa. These biocontrol agents are categorized as below:

**Egg parasites**

These parasites damage the egg stage of the harmful insect. Some of the commonly used egg parasites are *Trichogramma spp.*, *Telenomus spp.* and *Testrastichus sp.* These parasites control top shoot borer in sugarcane, internode borer in sugarcane, cotton bollworms, paddy stem borers, sorghum stem borers, fruit borers, etc.

**Larval parasites**

These parasites destroy the larval stages of pest insects. The classical example is *Bracon spp.* used in controlling black headed caterpillar in coconut and *Goppniozus nephantidis* used against the coconut leaf eating caterpillar.

**Pupal parasites**

The pupal stages of pests are destroyed by pupal parasites. *Testrastichus sp.* is widely used to control pests like American boll worm, paddy leaf rollers, black headed caterpillars, etc., in their pupal stages.

**Predators**

Predators like *Chrysopa sp*, *Menochilus spp.* are highly useful in controlling a wide variety of pests like aphids, whiteflies, cotton boll worms, leaf insects, etc. The eggs of these parasitoids are commercially available in the form of egg cards.

For example, the egg cards of the parasitoid *Trichogramma brasiliensis* are available commercially. Each egg card (e.g., *Trichogramma*) contains 20,000 live parasitised eggs which have 90–96% hatching potential within 7–10 days of parasitisation. These are applied @ 3–5 cards/ha. Each egg card cost Rs.20 to Rs.50. *Chrysopa sp.* is available in vials containing 1,000–5,000 live eggs/larvae. The standard recommendation for crops like cotton, sunflower, tobacco, groundnut, mustard and vegetables is 5,000–10,000 eggs/larvae per ha. Each vial cost Rs.150 to Rs.200.

**Table 4. Commercially important microbial bio-pesticides and biorationals used in India**

| S.No | Category | Products | Target pest | Major crops |
|---|---|---|---|---|
| 1. | Bacteria | *Bacillus thuringiensis*<br>*Bacillus sphaericus*<br>*Bacillus subtilis*<br>*Pseudomonas fluorescens* | Lepidoptera<br>Mosquitoes, Flies<br>Fungal pathogens<br>Fungal pathogens | Cotton, maize, vegetables, soybean, groundnut, wheat, peas, oilseeds,<br>rice |
| 2. | Fungi | *Trichoderma viride*<br>*Trichoderma harzianum*<br>*Trichoderma hamatum* | Fungal pathogens | Wheat, rice, pulses, vegetables, plantations, spices and sugarcane |
| | | *Beauveria bassiana*<br>*Verticillium lecanii*<br>*Metarhizium anisopliae*<br>*Paecilomyces lilacinus*<br>*Nomuraea rileyi* | Insect pests such as bollworms, white flies, root grubs, tea mosquito bugs. | Cotton, pulses, oilseeds, plantation crops, spices and vegetables |
| 3. | Viruses | Nuclear polyhedrosis Virus (NPV) of *Helicoverpa armigera*, *Spodoptera* sp. and *Chilo infescatellus* | American Boll worm, tobacco caterpillar and shoot borer | Cotton, sunflower, tobacco and sugarcane |
| 4. | Biorationals | Pheromone traps, Pheromone lures, sticky traps and mating disruptants | *Bactocera sp.*<br>*Chilo sp.*<br>*Dacus sp.*<br>*Earias vittella*<br>*Helicoverpa armigera*<br>*Leucinodes orbonalis*<br>*Pectinophora gossypiella*<br>*Plutella xylostella* | Cotton, sugarcane, vegetables, fruit crops |

*Source:* A Thimmaiah, *Current State of Inputs for Organic Agriculture.*

**Microbial pesticides**

The use of microorganisms as biocontrol agents is gaining importance in recent years. Biopesticides are living organisms or

their derived parts which are used as bio-control agents to protect crops against insect pests. Entomopathogenic viruses of baculovirus group, bacterial insecticides, particularly *Bacillus thuringiensis*, entomo-fungal pathogens, protozoans and insect parasitic nematodes have been found to control important pests of crops.

These biopesticides are commercially available and are quite difficult to formulate in field conditions.

**Types of microbial biopesticides**

- Bacterial biopesticides
- Fungal biopesticides
- Viral biopesticides

**Method of application of biopesticides**

- Seed treatment: 10 gm/kg of seed
- Nursery bed: 1 kg/100 kg soil mix
- Soil drenching: 10 gm/litre of water
- Seedling dip (30 min): 10 gm/litre of water
- Soil application: 5 kg/acre with FYM
- Foliar spray: 1 kg/acre

**Seed treatment with *Pseudomonas fluorescens* and *Trichoderma viride***

*Pseudomonas fluorescens* and *Trichoderma viride* (5 grams each per 100 gm of seeds) should be mixed with one litre of cooled rice gruel. The sprouted seeds required for one hectare should be spread on a clean floor and the bio-agents should be sprinkled over the seeds and mixed well.

***Trichoderma viride* (*TV*)**

*Trichoderma viride* is a fungus with multipurpose use in agriculture. As a biological pesticide, it is useful in fungal attack like wilt, rusting of leaves and root rot disease. It helps in germination of seed. It can enhance the growth of the plant and partly satisfies the nutrient requirements of the plant. *TV* is not harmful to either plants or animals.

### Seed treatment

- Seed must be washed first to get rid of any chemical fertilisers and pesticides.
- *TV* culture is taken @10 gm per kilo of seeds.
- The culture is mixed with starch to make it sticky.
- Seeds are coated with the paste and dried in the shade.
- The dried seeds are sown the same evening.

### Seedling treatment

- 20 gm of *TV* is mixed in a litre of water.
- The seedlings of brinjal, chili, tomato, cabbage, etc., are immersed in this mixture for five minutes before transplantation.
- For nursery treatment, 50 gm of *TV* culture is mixed with 500 gm of vermicompost or compost and mixed in 64.8 m2 of land.