ORGANIC MANAGEMENT
AN INTEGRATED APPROACH

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

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

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

IMPORTANT STEPS

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

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

HOW TO ACHIEVE

1. **Enrichment of soil** – Abandon use of chemicals, use crop residue as mulch, use organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.

2. **Management of temperature** – Keep soil covered, Plant trees and bushes on bund

3. **Conservation of soil and rain water** – Dig percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, dig farm ponds, maintain low height plantation on bunds.

4. **Harvesting of sun energy** – Maintain green stand throughout the year through combination of different
crops and plantation schedules.

5. **Self reliance in inputs** – develop your own seed, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts.

6. **Maintenance of life forms** – Develop habitat for sustenance of life forms, never use pesticides and create enough diversity.

7. **Integration of animals** – Animals are important components of organic management and not only provide animal products but also provide enough dung and urine for use in soil.

8. **Use of renewable energy** – Use solar energy, biogas and bullock driven pumps, generator and other machine.

**DEVELOPING ORGANIC FARM**

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

**DEVELOPMENT OF FARM FACILITIES AND HABITAT**

**Infrastructure** – Reserve 3-5% of farm space for utilities, such as space for cattle, vermicompost bed, compost tank, Vermiwash/ compost tea unit etc. 5-7 trees should be planted only on this space, as all utility infrastructure need shade. Irrigation well, water pumping infrastructure etc can also be in this utility area. Dig some percolation tanks (7x3x3mt or of any other size depending upon the rainfall and run-off pattern) for rain water conservation (1 pit per ha) at appropriate places depending upon slope and water flow. If possible develop a farm pond of preferably 20x10 mt size. Keep few 200 lit tanks (1 per acre) for liquid manure preparation and few containers for botanicals. For 5 acre farm, develop 1-2 vermicompost beds, 1 NADEP tank, 2 biodynamic compost beds, 2-3 compost tea/ vermiwash units, 5 liquid manure tanks, five cowpat pits and one underground cattle-urine collection tank. Efforts should also be made to produce sufficient quantities of BD-500 (cow horn manure) and BD-501 (cow horn silica). 10-12 horn products are sufficient for 5 acre farm. Use of biodynamic compost prepared with the use of BD-502-507 has also been found to be very effective.

**Habitat and biodiversity** - Management of an appropriate habitat for sustenance of different life forms is an essential component of organic farming. This can be achieved by ensuring crop diversity and by maintaining a wide variety of trees and bushes as per climatic suitability. These trees and bushes will not only ensure the nutrients from air and deep soil layers to surface layer but also attract the birds and predators, friendly insects and also provide the food and shelter. There may be some loss of productivity due to shading effect but that loss can be compensated with reduced pest problems and natural biological pest control system. In the plains, for a 10-acre farm, plant at least five to six neem trees (Azadirachta indica), one to two tamarind (Tamarindus indica), two gular (Ficus glumerata), eight to ten ber (Zizyphus Sp) bushes, one to two aonla (Emblica officinalis), one to two drumstick and 10-15 wild bushes.
CONVERSION OF SOIL TO ORGANIC

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

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

High input alternative – Incorporate 2.5-3.0 ton compost/ vermicompost or 1.5 ton of biodynamic compost, 500 kg crushed oil cakes, 500 kg rock phosphate, 100 kg neem cake, 5 kg Azotobacter and 5 kg PSB biofertilizer or 4 kg consortia of customized cultures in soil through broadcasting or by drilling in furrows below the seeds. Sow 3-4 types of different crops in strips. 40% crop stand should be of legumes. Randomly plant 100-150 marigold and vegetable seedlings for increased diversity. After harvest incorporate entire residue in soil or use as mulch after sowing of the next crop. For second crop also use similar quantities of manures. Use liquid manure (jivamruta) @ 200lit/acre 3-4 times during cropping season along with irrigation water. For increased productivity 2-3 sprays of vermiwash or vermiwash+ cow urine or Panchgavya can also be provided.

MULTIPLE CROPPING AND CROP ROTATION

Mix cropping is the outstanding feature of organic farming in which variety of crops are grown simultaneously or at different time on the same land. In every season care should be taken to maintain legume cropping at least 40%. Mix cropping promotes photosynthesis and avoids the competition for nutrients because different plants draw their nutrients from different depth of soil. The legume fixes atmospheric nitrogen and make available for companion or succeeding crops. Deep rooted plants drew nutrient from deeper layer of soil and bring them to the surface of soil through their leaf fall. So the nutrients leached down to lower strata are further brought back to upper layer by these deep rooted plants. Also help in protecting soil from soil erosion. Farmers should select the crops combination according to their needs and season.

In selecting crop combinations, it is also to be kept in mind that plants also have their feelings, likes and dislike e.g. maize gets along well with beans and cucumber, tomatoes go well with onions and marigold. On the other hand beans and onions do not go well with each other.
Crop rotation is the backbone of organic farming practices. To keep the soil healthy and to allow the natural microbial systems working, crop rotation is must. Crop rotation is the succession of different crops cultivated on same land. Follow 3-4 years rotation plan. All high nutrient demanding crops should precede and follow legume dominated crop combination. Rotation of pest host and non pest host crops helps in controlling soil borne diseases and pest. It also helps in controlling weeds. It is better for improving productivity and fertility of soil. Crop rotations help in improving soil structure through different types of root system. Legumes should be used frequently in rotation with cereal and vegetable crops. Green manure crops should also find place in planning rotations. High nutrient demanding crops should always be followed by legume crops and returned back to soil. Some important benefits of crop rotations are:

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

Under Network Project on Organic Farming (NPOF of ICAR) important cropping systems, which were found economically better or at par with conventional system at different experimental stations in the country are as follows:

- Soybean - Berseem/ Mustard/ chickpea at Raipur, Chattisgarh
- Tomato/ Cabbage – cauliflower – pea and maize – garlic at Bajaura, Himachal Pradesh
- Rice – wheat/ potato/ mustard/ lentil at Ranchi, Jharkhand
- Groundnut – rabi Sorghum, soybean – durum wheat, potato – chick pea, chilli+ Cotton and maize – chick pea at Dharwad, Karnataka
- Soybean – durum wheat/ mustard/ chick pea/ isabgol at Bhopal, M.P
- Maize – cotton, chillies – onion and brinjal – sunflower at Coimbatore
- Sorghum – pea – okra at Modipuram, Uttar Pradesh
- Carrot/ rice (pre kharif) – rice (kharif), potato/rice (pre kharif) – rice (kharif), French bean/ rice (pre kharif) – rice (kharif) at Umiam, Meghalaya.

**Status of rich and live organic soil** - A fertile and live organic soil ideally should have organic C between 0.8-1.5%. At any point of time it should have adequate quantity of dry, semi decomposed and fully decomposed organic matter for the use of micro-flora and fauna. Total microbial load (bacteria, fungi and actinomycetes) should be above $1 \times 10^8$ /gm of soil. There should be at least 3-5 earth worms/cubic ft of soil. There should be enough quantity of small life forms and insects such as ants etc.

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

- Hot water treatment at 53°C for 20-30 min.
- Cow urine or cow urine-termite mound soil paste
- Beejamrut
- Asphoetida 250gm in one lit. of water for 10 kg seed
- Turmeric rhizome powder mixed with cow urine
- Panchgavya extract
- Dashparni extract
- Trichoderma viride (4gm/kg seed) or Pseudomonas fluorescens (10gm/kg seed)
- Biofertilizers (Rhizobium/ Azotobacter +PSB)

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

**MANURING AND SOIL ENRICHMENT**

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

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

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

**USE OF BIOFERTILIZERS AND MICROBIAL CULTURES**

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

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

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

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

### SOME IMPORTANT FORMULATIONS FOR SOIL ENRICHMENT

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

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

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

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

- **Panchgavya** – Mix fresh cow dung 5 kg, cow urine
3 lit, cow milk 2 lit, curd 2 lit, cow butter oil 1 kg and ferment for 7 days with twice stirring per day. Dilute 3 lit of Panchgavya in 100 lit water and spray over soil. 20 lit panchgavya is needed per acre for soil application along with irrigation water.

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

**MANAGEMENT OF TEMPERATURE**

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

**PEST MANAGEMENT**

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

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

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

**Biological alternative** - Use of pest predators and pathogens has also proved to be effective method of keeping pest problem below ETL. Inundative release of Trichogramma sp. @ 40,000 to 50,000 eggs per hectare, Chelonus blackburni @15,000 to 20, 000 per hectare, Apanteles sp.@15,000 to 20,000 per ha and Chrysoperla sp.@ 5,000 per ha., after 15 days of sowing & others parasites & predators after 30 days of sowing, can also effectively control pest problem in organic farming.

**Use of Biopesticides** - Trichoderma viride or T. harzianum or Pseudomonasfluorescence formulation @ 4gm/kg seed either alone or in combination, manage most of the seed borne & soil borne diseases.
There are other formulations viz. Beauvaria bassiana, Metarizium anisopliae, Numeria rileyi, Verticillium sp, which are available in the market and can manage their specific host pest. Bacillus thurengensis stenebrionis and B. thurengensis sandigo are effective against coleopterans as well as some other insect species. Bt. has been used in the management of diamond back moth on crucifers and vegetables @ 0.5-1.0 kg. formulation per ha.

Viral biopesticides of baculovirus group viz. granulosis viruses (GV) and nuclear polyhedrosis viruses provided a great scope in plant protection field. Spray of nuclear polyhedrosis viruses (NPV) of Helicoverpa armigera (H) or Spodoptera litura (S) @ 250 larval equivalents are very effective tools to manage the Helicoverpa sp. or Spodoptera sp. respectively.

BOTANICAL PESTICIDES

Many plants are known to have pesticidal properties and the extract of such plants or its refined forms can be used in the management of pests. Among various plants identified for the purpose, neem has been found to be most effective.

Neem (Azadirachta indica) – Neem has been found to be effective in the management of approximately 200 insects, pests and nematodes. Neem is very effective against grasshoppers, leaf hoppers, plant hoppers, aphids, jassids, and moth caterpillars. Neem extracts, are also very effective against beetle larvae, butterfly, moth and caterpillars such as Mexican bean beetle, Colorado potato beetle and diamondback moth. Neem is very effective against grasshoppers, leaf minor and leaf hoppers such as variegated grasshoppers, green rice leaf hopper and cotton jassids. Neem is fairly good in managing beetles, aphids and white flies, mealy bug, scale insects, adult bugs, fruit maggots and spider mites.

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

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

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

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

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

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

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

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

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

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