JUST AGRICULTURE
multidisciplinary e-Newsletter

Organic Farming

*** Narender Kumar[1], Sonu Kumar[2] and Tarun Kumar[3]**
[1]Department of Agriculture, Dolphin (P.G.) Institute of Biomedical & Natural Science, Dehradun (UK)
[2]Department of Floriculture and Landscape, MHU, Karnal (Haryana)
[3]Indian Institute of Soil & Water Conservation, Dehradun (UK)

ARTICLE ID: 058

Introduction

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

Concept of organic farming

Organic farming is very much native to this land. Whosoever tries to write a history of organic farming will have to refer India and China. The farmers of these two countries are farmers of 40 centuries and it is organic farming that sustained them. This concept of organic farming is based on following principles:

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
- The soil in this system is a living entity
- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all cost.
- The total environment of the soil, from soil structure to soil cover is more important.

In today's terminology it is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. As per the definition of the USDA study team on organic farming "organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic In another definition FAO suggested that "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs". In philosophical terms organic farming means "farming in spirits of organic relationship. In this system everything is connected with everything else. Since organic farming means placing farming on integral relationship, we should be well aware about the relationship between the soil, water and plants, between soil-soil microbes and waste products, between the vegetable kingdom and the animal kingdom of which the apex animal is the human being, between agriculture and forestry, between soil, water and atmosphere etc. It is the totality of these relationships that is the bed rock of organic farming.

The world of organic agriculture As per the details released at BioFach 2010 at Nuremberg, the organic agriculture is developing rapidly, and statistical information is now available from 154 countries of the world. Its share of agricultural land and farms continues

JUST AGRICULTURE
multidisciplinary e-Newsletter

to grow in many countries. The main results of the latest global survey on certified organic farming are summarized below:

Growing area under certified organic agriculture

- 35 million hectares of agricultural land are managed organically by almost 1.4 million producers.
- The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares), Europe (8.2 million hectares) and Latin America (8.1 million hectares). The countries with the most organic agricultural land are Australia, Argentina and China.
- The highest shares of organically managed agricultural land are in the Falkland Islands (36.9 percent), Liechtenstein (29.8 percent) and Austria (15.9 percent).
- The countries with the highest numbers of producers are India (340'000 producers), Uganda (180'000) and Mexico (130'000). More than one third of organic producers are in Africa.
- On a global level, the organic agricultural land area increased in all regions, in total by almost three million hectares, or nine percent, compared to the data from 2007.
- Twenty-six percent (or 1.65 million hectares) more land under organic management was reported for Latin America, mainly due to strong growth in Argentina. In Europe the organic land increased by more than half a million hectares, in Asia by 0.4 million.
- About one-third of the world's organically managed agricultural land – 12 million hectares is located in developing countries. Most of this land is in Latin America, with Asia and Africa in second and third place. The countries with the largest area under organic management are Argentina, China and Brazil.
- 31 million hectares are organic wild collection areas and land for bee keeping. The majority of this land is in developing countries – in stark contrast to agricultural land, of which two-thirds is in developed countries. Further organic areas include aquaculture areas (0.43 million hectares), forest (0.01 million hectares) and grazed non-agricultural land (0.32 million hectares). Almost two-thirds of the agricultural land under organic management is grassland (22 million hectares). The cropped area

JUST AGRICULTURE
multidisciplinary e-Newsletter

(arable land and permanent crops) constitutes 8.2 million hectares, (up 10.4 percent from 2007), which represents a quarter of the organic agricultural land.

Organic Agriculture in India Emergence The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons. First category of organic farmers are those which are situated in no-input or low-input use zones, for them organic is a way of life and they are doing it as a tradition (may be under compulsion in the absence of resources needed for conventional high input intensive agriculture). Second category of farmers are those which have recently adopted the organic in the wake of ill effects of conventional agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. The third category comprised of farmers and enterprises which have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. While majority of farmers in first category are traditional (or by default) organic they are not certified, second category farmers comprised of both certified and un-certified but majority of third category farmers are certified. These are the third category commercial farmers which are attracting most attention. The entire data available on organic agriculture today, relates to these commercial organic farmers Growing area Emerging from 42,000 ha under certified organic farming during 2003-04, the organic agriculture has grown almost 29 fold during the last 5 years. By March 2010 India has brought more than 4.48 million ha area under organic certification process.

Out of this cultivated area accounts for 1.08 million ha while remaining 3.4 million ha is wild forest harvest collection area. Year wise growth of cultivated area under organic management is shown in Table 1. Overall status of organic production projects, processors, quantity produced, quantity exported and the value of export is given in Table 2, State wise details of total area and number of farmers under full organic, inconversion and total under organic management (2009-10) are given in Table 3. Details in respect of important commodities produced during 2008-09 are given in Table 4. Regulatory mechanism For quality assurance the country has internationally acclaimed certification process in place for export, import and domestic markets.

National Programme on Organic Production (NPOP) defines the regulatory mechanism and is regulated under two different acts for export and domestic markets. NPOP notified

JUST AGRICULTURE
multidisciplinary e-Newsletter

under Foreign Trade Development and Regulation Act (FTDR) looks after the export requirement. The NPOP notified under this act has already been granted equivalence by European Union and Sweden. USDA has also accepted the conformity assessment system of NPOP. Due to this, the product certified by any Indian accredited certification agency under NPOP can be exported to Europe, Sweden and USA without the requirement of re-certification. To look after the requirement of import and domestic market the same NPOP has been notified under Agriculture Produce Grading, Marking and Certification Act (APGMC). Regulatory body of NPOP under FTDR act is Agricultural and Processed Foods Export Development Authority (APEDA) under Ministry of Commerce and of NPOP under APGMC act is Agricultural Marketing Advisor (AMA) under Ministry of Agriculture. Accreditation of Certification and Inspection Agencies is being granted by a common National Accreditation Body (NAB). 18 accredited certification agencies are looking after the requirement of certification process. Out of these 4 agencies are under public sector while remaining 14 are under private management.

Growing Crops under Organic Management

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

- 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, bio-gas and bullock driven pumps, generator and other machine.

Developing organic farm

As organic management is an integrated approach, manipulation and adoption of one or few steps may not yield significant results. For optimization of productivity all the essential components need to be developed in a systematic manner. These steps include:

(i) Habitat development,

JUST AGRICULTURE
multidisciplinary e-Newsletter

(ii) On-farm facilities for input production

(iii) Cropping sequence and combination planning,

(iv) 3-4 year rotation plan and

(v) 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. More specifically, if we classify areas into wet and dry

JUST AGRICULTURE
multidisciplinary e-Newsletter

farms, then on the wet farms there should be five to six neem trees, one to two wood apples, one to two star fruit, eight to ten guava or sour soap, three to four drumstick, one to two fig and 10–15 bushes of mulberry, star gooseberry, curry leaf etc, and on the dry farms there must be at least five to six neem, one to two bael fruit, eight to ten ber or custard apple, one to two aonla , one to two drumstick and 10–15 bushes of sasaka , nirgundi (*Vitex negundo*), *Cassia auriculata*, *C. tora*, etc.

In hilly areas, *Alnus nepalensis* is considered to be a wonder tree as it fixes good amount of nitrogen. It is being promoted in a cropping system mode particularly in northeastern India. Bushes of Prunus, oak (*Quercus glauca*), Pinus species along the farm boundary and yarrow (*Achillea millifolium*), buck wheat (*Fagopyrum esculentum*), lupin (*Lupinus sativus*), Himalayan stinging nettle (*Urtica parviflora*), marigold, etc., in between the plots invite a lot of predators and also attract a large number of pests. Fruit orchards also need to maintain adequate diversity with at least 3-5 types of fruit plants and few non-fruit trees (as listed above). Major and minor plots should be separated by bunds about 1.5m wide and should be planted with Glyricidia, perennial Sesbania (jayanti), Leucaena leucocephala, cassia siamea, etc. The internal hedgerow should consist of perennial pigeon pea, crotalaria, seasonal Sesbania, etc. Lops from these trees will provide enough quantity of biologically fixed nitrogen.

In between *Glyricidia/Sesbania* rows insert few plants of pesticidal value such as *Adathoda vesica, Vitax nigundo, Calotropis, Datura alba, Ipomea* (Besharam) etc. Surrounding the farm or garden, there should be hedgerows or a live fence of coppiced or pollarded, multipurpose, deep-rooted trees and shrubs and medicinal herbs such as Adathoda vasica, Vitex negundo, Jatropha curcas, etc. Ecological diversity is an essential component of any successful organic farming system. Trees on utility space can be allowed to grow fully. Trees and bushes on farm bunds should be placed randomly at sufficient distance and pruned at repeated intervals. Glyricidia plants should be planted at close spacing on all major bunds and all around the farm. They will act not only as biological fence but also provide biologically fixed nitrogen to soil.

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

Conversion of soil to organic

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

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

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

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

Multiple cropping and crop rotation

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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. Entire farm should have at least 8-10 types of crops at all the times. Each field/ plot should have at least 2-4 types of crops out of which one should be legume. In case if only one crop is taken in one plot then adjacent plots should have different crops. For maintenance of diversity and pest control randomly plant 50-150/acre vegetable seedlings for home consumption and 100 plants/acre of marigold (Genda) in all crop fields. Even high nutrient demanding crops such as sugarcane can also be grown with suitable combination of various legume and vegetable crops with optimum productivity.

Crop rotation

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

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

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Rice – wheat/ potato/ mustard/ lentil at Ranchi, Jharkhand
- Groundnut – rabi Sorghum, soybean – durum wheat, potato – chick pea, chillil+ Cotton and maize – chick pea at Dharwad, Karnataka
- Soybean – durum wheat/ mustard/ chick pea/ isabgol at Bhopal, M.P.
- Rice – durum wheat/ berseem, rice – potato – Okra and rice – garlic, sorghum – berseem, maize – berseem – maize + cowpea and sorghum + cluster bean – oats-cowpea at Ludhiana, Punjab
- 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), tomato/ 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 x 108 /gm of soil. There should be at least 3-5 earth worms/cubic ft of soil. There should be enough quantity of small life forms and insects such as ants etc.

Seed/ Planting material Treatment

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

- Hot water treatment at 530C for 20-30 min.
- Cow urine or cow urine-termite mound soil paste
- Beejamrut
- Asphoetida 250gm in one lit. of water for 10 kg seed
- Turmeric rhizome powder mixed with cow urine
- Panchgavya extract
- Dashparni extract

JUST AGRICULTURE
multidisciplinary e-Newsletter

- *Trichoderma viride* (4gm/kg seed) or *Pseudomonas fluorscens* (10gm/kg seed)
- Biofertilizers (Rhizobium/ Azotobacter +PSB)
-

Preparation of Beejamruta

Put 5 kg fresh cow dung in a cloth bag and suspend in a container filled with water to extract the soluble ingredients of dung. Suspend 50 g lime in 1lit 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.

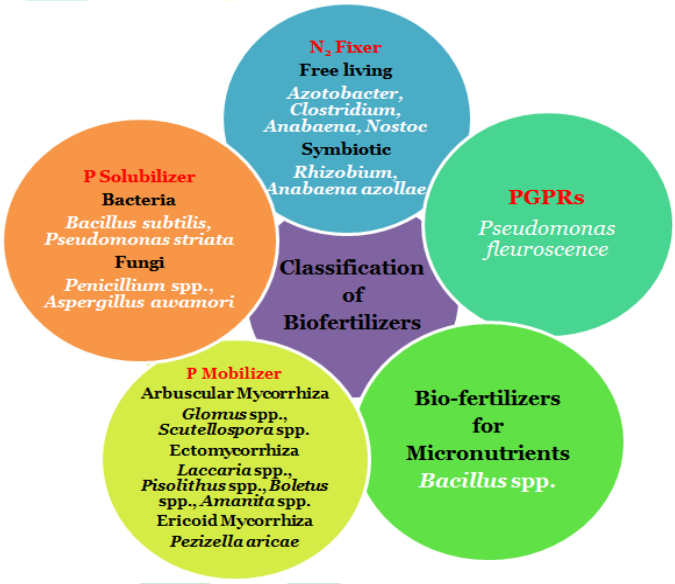
Lopping from Glyricidia and other plants grown on bunds, on-farm produced compost and vermicompost, animal dung and urine and crop residue should form the major source of nutrient and concentrated manures such as crushed oil cakes, poultry manure, vegetable market waste compost and other novel preparations 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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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 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 no-chemical use situations, therefore application of such inputs need to be ensured under all cropping situations.



Method of application

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

1. **Seed treatment** Suspend 200 gm each of nitrogen fixing and PSB in 300-400 ml of water and mix thoroughly. Pour this slurry on 10 to 12 kg of seed and mix by hands, till all the seeds are uniformly coated. Dry the treated seeds in shade and sow immediately. For acidic and alkaline soils it is always advisable to use 1kg of slacked lime or gypsum powder respectively for coating the wet biofertilizer treated seeds.
2. **Seedling root dip treatment: -** Suspend 1 to 2 kg each of nitrogen fixing (*Azotobacter*/*Azospirillum*) and PSB into just sufficient quantity of water (5-10 lit depending upon the quantity of seedlings required to be planted in one acre). Dip the

JUST AGRICULTURE
multidisciplinary e-Newsletter

roots of seedlings in this suspension for 20-30 min before transplanting. In case of paddy make a sufficient size bed (2mt x 1.5mt x 0.15mt) in the field, fill it with 5 cm of water and suspend 2 kg each of *Azospirillum* and PSB and mix thoroughly. Now dip the roots of seedlings in this bed for 8-12 hours (overnight) and then transplant.

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

Some important formulations for soil enrichment

Preparation of liquid manures

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

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

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

Amritpani - Mix 10 kg cow dung with 500 gm honey and mix thoroughly to form a creamy paste. Add 250 gm of cow desi ghee and mix at high speed. Dilute with 200 lit. water.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Sprinkle this suspension in one acre over soil or with irrigation water. After 30days apply second dose in between the row of plants or through irrigation water.

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

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

Management of Temperature

Temperature in summer season is quite high and need to be managed. It can be achieved by keeping soil covered with biological mulch. Surface mulch has been reported to conserve soil moisture and improve water use efficiency **(Hajare et al 1997**). In the long term experiment at ICRISAT, it has been reported that mulch applied in this manner on the hottest day of summer (April 30) in 2002 the soil temperature at 5 and 10 cm depth in the mulch applied plots was 6.5 to 7.3^{0}C lower than in control plot (Rupela *et al* 2005). Temperature control can also be achieved by planting different types of trees like neem, amla, tamarind, gular, zizipus bushes, gliricidia on bunds.

Protection to all life forms

Practice of maintaining enough biomass and mulching with crop and weed residue will ensure the protection to all life forms in soil. Another important practice of banning the

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

Pest management

As in organic farming management use of synthetic chemicals are prohibited, the pest management is done by:

I. Cultural or agronomic
II. Mechanical
III. Biological or by
IV. Organically acceptable botanical extract or some chemicals such as copper sulphate and soft soap etc.

Cultural alternative

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

Mechanical alternative

JUST AGRICULTURE
multidisciplinary e-Newsletter

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. harazianum* or *Pseudomonas fluorescence* formulation @ 4gm/kg seed either alone or in combination, manage most of the seed borne & soil borne diseases. There are other formulations viz. *Beauvaria bassiana*, *Metarizium anisopliae*, *Numeria rileyi*, *Verticillium* sp, which are available in the market and can manage their specific host pest. *Bacillus thurengensis stenebrionis and B.thurengensis sandigo* are effective against coleopterans as well as some other insect species. Bt. has been used in the management of diamond back moth on crucifers and vegetables @ 0.5-1.0 kg. formulation per ha. Viral biopesticides of baculovirus group viz. granulosis viruses (GV) and nuclear polyhedrosis viruses provided a great scope in plant protection field. Spray of nuclear polyhedrosis viruses (NPV) of *Helicoverpa armigera* (H) or *Spodoptera litura* (S) @ 250 larval equivalents are very effective tools to manage the *Helicoverpa* sp. or *Spodoptera* sp. respectively.

Botanical pesticides

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

Neem (*Azadirachta indica*)

Neem has been found to be effective in the management of approximately 200 insects, pests and nematodes. Neem is very effective against grasshoppers, leaf hoppers, plant

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

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

Mixed leaves extract

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

Chilli-garlic extract

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

Broad spectrum formulation

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

Broad spectrum formulation –

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

JUST AGRICULTURE
multidisciplinary e-Newsletter

Some Other forms of Organic Management and Innovate Inputs

1. Biodynamic Agriculture

What is organic farming?

Organic farming works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. The methods and materials that organic farmers use are summarised as follows:

To keep and build good soil structure and fertility:

- Recycled and composted crop wastes and animal manures
- The right soil cultivation at the right time
- Crop rotation
- Green manures and legumes
- mulching on the soil surface

To control pests, diseases and weeds:

- Careful planning and crop choice
- The use of resistant crops
- Good cultivation practice
- Crop rotation
- Encouraging useful predators that eat pests
- Increasing genetic diversity
- Using natural pesticides

Organic farming also involves:

- Careful use of water resources
- Good animal husbandry

A modern approach to farming

Organic farming does not mean going 'back' to traditional methods. Many of the farming methods used in the past are still useful today. Organic farming takes the best of these and combines them with modern scientific knowledge. Organic farmers do not leave their farms to be taken over by nature; they use all the knowledge, techniques and materials available to work with nature. In this way the farmer creates a healthy balance between nature and farming, where crops and animals can grow and thrive. To be a successful organic

JUST AGRICULTURE
multidisciplinary e-Newsletter

farmer, the farmer must not see every insect as a pest, every plant out of place as a weed and the solution to every problem in an artificial chemical spray. The aim is not to eradicate all pests and weeds, but to keep them down to an acceptable level and make the most of the benefits that they may provide.

Combined techniques

On an organic farm, each technique would not normally be used on its own. The farmer would use a range of organic methods at the same time to allow them to work together for the maximum benefit. For example the use of green manures and careful cultivation, together provide better control of weeds than if the techniques were used on their own.

Why farm organically?

Organic farming provides long-term benefits to people and the environment. Organic farming aims to:

- Increase long- term soil fertility.
- Control pests and diseases without harming the environment
- Ensure that water stays clean and safe.
- Use resources which the farmer already has, so the farmer needs less money to buy farm inputs.
- Produce nutritious food, feed for animals and high quality crops to sell at a good price.

Modern, intensive agriculture causes many problems, including the following:

- Artificial fertilisers and herbicides are easily washed from the soil and pollute rivers, lakes and water courses.
- The prolonged use of artificial fertilisers results in soils with a low organic matter content which is easily eroded by wind and rain.
- Dependency on fertilisers. Greater amounts are needed every year to produce the same yields of crops.
- Artificial pesticides can stay in the soil for a long time and enter the food chain where they build up in the bodies of animals and humans, causing health problems.
- Artificial chemicals destroy soil micro-organisms resulting in poor soil structure and aeration and decreasing nutrient availability.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Pests and diseases become more difficult to control as they become resistant to artificial pesticides. The numbers of natural enemies decrease because of pesticide use and habitat loss.

Crop nutrition

To produce a healthy crop an organic farmer needs to manage the soil well. This involves considering soil life, soil nutrients and soil structure. Artificial fertilisers provide only short term nutrient supply to crops. They encourage plants to grow quickly but with soft growth which is less able to withstand drought, pests and disease. Artificial fertilisers do not feed soil life and do not add organic matter to the soil. This means that they do not help to build good soil structure, improve the soils water holding capacity or drainage. The soil is a living system. As well as the particles that make up the soil, it contains millions of different creatures. These creatures are very important for recycling nutrients. Feeding the soil with manure or compost feeds the whole variety of life in the soil which then turns this material into food for plant growth. This also adds nutrients and organic matter to the soil. Green manures also provide nutrients and organic matter. These are plants with high nitrogen content that are sown as part of a rotation and are dug into the soil when young. It is important to remember, however, that using too much animal manure or nutrient rich organic matter, or using it at the wrong time, could be as harmful as using man-made, artificial fertilisers. The organic farmer must cultivate the soil at the right time and in the right ways to provide the best living conditions for the soil life and plant roots.

Choice of crops

Each crop and crop variety has its own specific needs. In some places it will grow well and others it will not. Crops are affected by;

- Soil type
- Rainfall
- Altitude
- Temperature
- The type and amount of nutrients required
- The amount of water needed

These factors affect how a crop grows and yields. If a crop is grown in a climate to which it is not suited, it is likely to produce low yields and be more susceptible to pest and diseases.

JUST AGRICULTURE
multidisciplinary e-Newsletter

This then creates the need to use agrochemicals to fertilise the crop and control pest and diseases. The successful organic farmer learns to grow the crops and varieties which are suited to the local conditions. He should grow crops which are suited to his geography and climate. He should choose varieties which are suited to the local conditions such as local varieties.

Rotations

Growing the same crops in the same site year after year reduces soil fertility and can encourage a build up of pests, diseases and weeds in the soil. Crops should be moved to a different area of land each year, and not returned to the original site for several years. For vegetables a 3 to 4 year rotation is usually recommended as a minimum. Crop rotation means having times where the fertility of the soil is being built up and times where crops are grown which remove nutrients. Crop rotation also helps a variety of natural predators to survive on the farm by providing diverse habitats and sources of food for them. A typical 4 year rotation would include a cycle with maize and beans, a root crop and cereals with either of the following; 1. Grass or bush fallow (a fallow period where no crops are grown). 2. A legume crop where a green manure, which is a plant grown mainly for the benefit of the soil, is grown (more information about green manures can be obtained from HDRA).

Composting

Compost is organic matter (plant and animal residues) which has been rotted down by the action of bacteria and other organisms, over a period of time. Materials such as leaves, fruit skins and animal manures can be used to make compost. Compost is cheap, easy to make and is a very effective material that can be added to the soil, to improve soil and crop quality.

- Compost improves the structure of the soil. This allows more air into the soil, improves drainage and reduces erosion.
- Compost improves soil fertility by adding nutrients and by making it easier for plants to take up the nutrients already in the soil. This produces better yields.
- Compost improves the soil's ability to hold water. This stops the soil from drying out in times of drought.
- Compost can reduce pests and diseases in the soil and on the crop.

Compost has many advantages over chemical fertilisers. These provide nutrients for plants but do not improve soil structure. They usually only improve yields in the season in which

JUST AGRICULTURE
multidisciplinary e-Newsletter

they are applied. Because compost feeds soil life and improves soil structure, the beneficial effects are long lasting.

There are many ways to make compost depending on available materials and climate, for example:

- Indore method
- Bangalore method
- Heating process/Block method
- Chinese high temperature stack
- Pit composting
- Trench composting
- Basket composting
- Boma composting

Mulching

Mulching means covering the ground with a layer of loose material such as compost, manure, straw, dry grass, leaves or crop residues. Green vegetation is not normally used as it can take a long time to decompose and can attract pests and fungal diseases. Mulches have several effects on the soil which help to improve plant growth:

- Decreasing water loss due to evaporation
- Reducing weed growth by reducing the amount of light reaching the soil
- Preventing soil erosion
- Increasing the number of micro-organisms in the top soil
- Adding nutrients to the soil and improving soil structure
- Adding organic matter to the soil Alternative mulching materials include black plastic sheeting or cardboard. However these materials do not add nutrients to the soil or improve its structure.

How to use mulches

- Always apply mulches to a warm, wet soil. Mulch applied to a dry soil will keep the soil dry.
- Care should be taken as to the thickness of the mulch applied. Too much mulch will prevent air flow and encourage pests.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- To allow the germination of planted seeds through the mulch, a layer of less than 10cm should be used.
- To clear an area of land of persistent weeds a layer of 10cm or more can be used.

Green manures

Green manures, often known as cover crops, are plants which are grown to improve the structure, organic matter content and nutrient content of the soil. They are a cheap alternative to artificial fertilisers and can be used to complement animal manures. Growing a green manure is not the same as simply growing a legume crop, such as beans, in a rotation. Green manures are usually dug into the soil when the plants are still young, before they produce any crop and often before they flower. They are grown for their green leafy material which is high in nutrients and provides soil cover. They can be grown together with crops or alone. Green manures:

- Increase and recycle plant nutrients and organic matter
- Improve soil fertility
- Improve soil structure
- Improve the ability of the soil to hold water
- Control soil erosion
- Prevent weed growth
- Stop nutrients being washed out of the soil, for example, when the ground is not used between main crops.

Weed control

In organic farming systems, the aim is not necessarily the elimination of weeds but their control. Weed control means reducing the effects of weeds on crop growth and yield. Organic farming avoids the use of herbicides which, like pesticides, leave harmful residues in the environment. Beneficial plant life such as host plants for useful insects may also be destroyed by herbicides. On an organic farm, weeds are controlled using a number of methods:

- Crop rotation
- Hoeing
- Mulches, which cover the soil and stop weed seeds from germinating
- Hand-weeding or the use of mechanical weeders
- Planting crops close together within each bed, to prevent space for weeds to emerge

JUST AGRICULTURE
multidisciplinary e-Newsletter

- ❖ Green manures or cover crops to outcompete weeds
- ❖ Soil cultivation carried out at repeated intervals and at the appropriate time, when the soil is moist. Care should be taken that cultivation does not cause soil erosion.
- ❖ Animals as weeders to graze on weeds

Weeds do have some useful purposes. They can provide protection from erosion, food for animals and beneficial insects and food for human use.

Natural pest and disease control

Pests and diseases are part of nature. In the ideal system there is a natural balance between predators and pests. If the system is imbalanced then one population can become dominant because it is not being preyed upon by another. The aim of natural control is to restore a natural balance between pest and predator and to keep pests and diseases down to an acceptable level. The aim is not to eradicate them altogether.

Chemical control

Pesticides do not solve the pest problem. In the past 50 years, insecticide use has increased tenfold, while crop losses from pest damage have doubled. Here are three important reasons why natural control is preferable to pesticide use.

Safety for people

Artificial pesticides can quickly find their way into food chains and water courses. This can create health hazards for humans. Human health can also be harmed by people eating foods (especially fruit and vegetables) which still contain residues of pesticides that were sprayed on the crop. There is also much concern for those people using chemical pesticides. The products may be misused because the instructions are not written in the language spoken by the person using them. This has led to many accidents such as reports of people suffering from severe skin rashes and headaches as a result of using chemical pesticides. There are an estimated one million cases of poisoning by pesticides each year around the world. Up to 20,000 of these result in death. Most of the deaths occur in tropical countries where chemical pesticides which are banned in Europe or the USA are still available.

Cost

Using natural pest and disease control is often cheaper than applying chemical pesticides because natural methods do not involve buying materials from the outside.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Products and materials which are already in the home and around the farm are most often used. Safety for the environment

There are a number of harmful effects that chemical pesticides can have on the environment:

- Chemical pesticides can kill useful insects which eat pests. Just one spray can upset the balance between pests and the useful predators which eat them.
- Artificial chemicals can stay in the environment and in the bodies of animals causing problems for many years.
- Insect pests can very quickly, over a few breeding cycles, become resistant to artificial products and are no longer controlled. This means that increased amounts or stronger chemicals are then needed creating further economic, health and environmental problems.

Natural control

There are many ways in which the organic farmer can control pests and diseases.

- Growing healthy crops that suffer less damage from pests and diseases.
- Choosing crops with a natural resistance to specific pests and diseases. Local varieties are better at resisting local pest and diseases than introduced varieties.
- Timely planting of crops to avoid the period when a pest does most damage.
- Companion planting with other crops that pests will avoid, such as onion or garlic.

Trapping or picking pests from the crop.

- Identifying pest and diseases correctly.

This will prevent the farmer from wasting time or accidentally eliminating beneficial insects. It is therefore useful to know life cycles, breeding habits, preferred host plants and predators of pests. Using crop rotations to help break pest cycles and prevent a carry over of pests to the next season.

- Providing natural habitats to encourage natural predators that control pests. To do this, the farmer should learn to recognise insects and other animals that eat and control pests.

Through careful planning and using all the other techniques available it should be possible to avoid the need for any crop spraying. If pests are still a problem natural products can be used to manage pests, including sprays made from chillies, onions, garlic or neem. Further information can be obtained from HDRA.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Even with these natural pesticides, their use should be limited as much as possible and only the safest ones used. It is wise to check with national and international organic standards to see which ones are allowed or recommended.

Genetic diversity

Within a single crop there can be many differences between plants. They may vary in height or ability to resist diseases, for example. These differences are genetic. Traditional crops grown by farmers contain greater genetic diversity than modern bred crops. Traditional varieties have been selected over many centuries to meet the requirements of farmers. Although many are being replaced by modern varieties, seeds are often still saved locally.

Crops which have been bred by modern breeding methods tend to be very similar and if one plant is prone to disease, all the other plants are as well. Although some modern varieties may be very resistant to specific pests and diseases they are often less suited to local conditions than traditional varieties. It can therefore be dangerous to rely too much on any one of them.

In organic systems, some variation or 'genetic diversity' between the plants within a crop is beneficial. Growing a number of different crops rather than relying on one is also very important. This helps to protect against pests and diseases and acts as insurance against crop failure in unusual weather such as drought or flood. It is important to remember this when choosing which crops to grow.

An organic farmer should try to:

- Grow a mixture of crops in the same field (mixed cropping, intercropping, strip cropping)
- Grow different varieties of the same crop
- Use as many local crop varieties as possible
- Save the seed of local and improved crop varieties rather than relying on buying seed from outside the farm every year. Exchange of seed with other farmers can also help to increase diversity, and ensure the survival of the many traditional crop varieties which are being lost as they are replaced by a few modern varieties.

Careful use of water

In arid lands the careful use of water is as much a part of organic growing as is any other technique.

JUST AGRICULTURE
multidisciplinary e-Newsletter

As with other resources, organic farmers should try to use water which is available locally, avoiding using water faster than it is replaced naturally. There are many ways to use water carefully, including:

- The use of terracing, rain water basins or catchments and careful irrigation
- The addition of organic matter to the soil to improve its ability to hold water
- The use of mulches to hold water in the soil by stopping the soil surface from drying out or becoming too hot

Animal husbandry

In an organic system, the welfare of the animals is considered very important.

- Animals should not be kept in confined spaces where they cannot carry out their natural behaviour such as standing and moving around in an inadequate amount of space. However, care should be taken that animals do not damage crops.
- Food for animals should be grown organically.
- Breeds should be chosen to suit local needs and local conditions and resources

These factors help to ensure that livestock are more healthy, better able to resist diseases and to provide good yields for the farmer.

International standards

The International Federation of Organic Agriculture Movements (IFOAM) has produced a set of international organic standards, laid down by people from many countries. These give guidelines about what organic farming is and how it should be practised on the farm.

International standards are also used to help countries set their own standards, which take into account different farming systems. Many countries have an organic standards authority which lays down national standards and awards a symbol to farms which have followed the standards. This symbol then allows farmers to market certified organic produce. This is important, as it ensures that people know that the food which they buy is organic.

The main principles of organic farming were laid down by IFOAM in 1992.

- To produce food of high nutritional quality in sufficient quantity.
- To interact in a constructive and life enhancing way with all natural systems and cycles.
- To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- To maintain and increase long term fertility of soils.
- To use, as far as possible, renewable resources in locally organised agricultural systems.
- To work, as far as possible, within a closed system with regard to organic matter and nutrient elements. This aims to reduce external inputs.
- To work, as far as possible, with materials and substances which can be reused or recycled, either on the farm or elsewhere.
- To give all livestock living conditions which will allow them to perform the basic aspects of their innate behaviour.
- To minimise all forms of pollution that may result from agricultural practices.
- To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats.
- To allow agricultural producers a living according to the UN human rights; to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment.
- To consider the wider social and ecological impact of the farming system.

Organic food is becoming popular in Europe and America. However for food to be sold as organic it must bear a symbol that proves that it is truly organic. This is obtained through a certification organisation. This is quite a complex procedure and is potentially expensive if there are not certification organisations in your country. Please contact HDRA for further information about how to become a certified organic producer.

References

Field Notes on Organic Farming (1994) JW Njoroge. Kenya Institute of Organic Farming, PO Box 34972, Nairobi,

Kenya Natural Crop Protection Based on Local Farm Resources in the Tropics and Subtropics (1986) G Stoll. Intermediate Technology Publications, 103- 105 Southampton Row, London WC1B 4HH, UK .

Natural Pest and Disease Control (date unknown) H Elwell and A Mass. Natural Farming Network, PO Box CY 301, Causeway, Harare, Zimbabwe Sustainable Agriculture

Practices and Technologies: Guidelines for farmers (1997). Africa 2000 Network, UNDP, PO Box 7184, Kampala, Uganda.

Regenerative Agricultural Technologies-Trainors Kit (1990). International Institute of Rural Reconstruction, Rm 38 Elena Apts, 512 Romero Salas St., Ermita, Manila, Philippines