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Session-3.2



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Soil enhancement

- Undertake soil testing at authorized centres
- Understand soil test data for soil amendment and manuring .
- Select appropriate crops suiting to soil condition
- Calculate nutrient needs based on test report and local crop recommendations .



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- Prepare the land to get appropriate tilth (land preparation is done in two steps that is primary n secondary cultivations ,both operations should be done during dry season.
- Primary tillage entails deep penetration of the soil up to a depth of 15-75 cm by the use of heavy machinery mould board plough,listers, rotary tillers.
- Secondary tillage is done to pulverize, level and firm the top layer 5-15 cm .The main machines are disk harrow ,cultivators and rotary tillers).



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- Identify various methods adopted in organic farming for building organic matter in soil
- Grow green manure crop and incorporate biomass

Green manures are plants grown to accumulate nutrients for the main crop. When they have built up maximum biomass, they are worked into the surface soil. As they are usually cut before flowering, growing a green manure is thus different from growing a legume crop in the rotation



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Once worked into the soil the fresh plant material releases nutrients quickly and will be fully decomposed within a short period of time. Old or coarse material (e.g. straw, twigs, etc.) will decompose at a slower rate than fine material and will therefore contribute more to the build-up of soil organic matter than to fertilizing the crop.



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- An alternative to sowing a green manure crop in the field is to collect fresh plant material from elsewhere and work it into the soil. For example, trees and/or shrubs growing alongside crops in an agroforestry system may provide a large quantity of green material which can be used as green manure or for mulching.



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1. Green manures have a number of benefits:

- They penetrate the soil with their roots, make it more friable and bind nutrients, which would otherwise be washed away.
- They suppress weeds and protect the soil from erosion and direct sunlight.
- If legume plants are used, nitrogen is fixed from the air into the soil.



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- Some green manures can be used as fodder plants or even to provide food for human consumption (e.g. beans and peas).
- By decomposing, green manures release all kinds of nutrients in the correct mixture for the main crops to utilize thus improving their yield.
- The incorporated plant material encourages the activity of soil organisms, and builds up organic matter in the soil. This improves soil structure and water holding capacity.

Green manuring is thus an inexpensive way to improve soil fertility and the nutrition of the main crops grown.



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2. Factors to consider before growing green manures:

- Labour is required for tillage, sowing, cutting and incorporation of plants into the soil, and is most intensive where the amount of helpful equipment available is small.
- If green manures are intercropped with the main crops, they compete for nutrients, water and light.



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- When old or coarse plant material is incorporated into the soil, nitrogen may be temporarily immobilised and therefore unavailable for plant growth.
- If food and space are in short supply it may be more appropriate to grow a food crop rather than a green manure and recycle the crop residues, or to intercrop a green manure crop with the main crop.
- The benefits of green manures occur over the long term and are not always visible immediately.



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3. How to use green manures:

a) Sowing the green manure:

- If grown within a crop rotation, the time of sowing must be chosen such that the green manure can be cut down and worked into the soil before the next crop is sown.
- Green manures need water for germination and growth.
- The ideal seed density must be tested for each individual situation. It depends on the species chosen.



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- In general no additional fertilization is necessary. If legumes are grown in a field for the first time, inoculation of the seeds with the specific rhizobia may be necessary to profit from nitrogen fixation of the legume.
- b) Working the green manure into the soil
 - Timing: The time gap between digging in the green manure and planting the next crop should not be longer than 2 to 3 weeks, so as to prevent nutrient losses from the decomposing green manure.



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Crushing: Green manures are worked in most easily when the plants are still young and fresh. If the green manure plants are tall or contain bulky and hard plant parts, it is preferable to chop the plants into pieces to allow easier decomposition.

- The older the plants, the longer decomposition will take. The best time to dig in green manure plants is just before flowering.



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- **Depth of incorporation:** Green manures should not be ploughed deeply into the soil. Instead they should only be worked in to the surface soil (in heavy soils only 5 to 15 cm deep, in light soils 10 to maximum 20 cm deep). In warm and humid climates the material can also be left on the soil surface as a mulch layer.



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c) How to choose the right species?

There is a large variety of plants, especially legumes that can be used as green manure crops. It is important that appropriate species are chosen.

- Most importantly they should be adapted to the local growing conditions, especially rainfall and soil, fit into the crop rotation and not pose a risk of transmitting diseases and pests to other crops.



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2. Animal manure

- Depending on whether animals are kept in stables or not (part or full time), farmyard manure consists of animal excreta and bedding material (usually straw or grass). Farmyard manure is extremely valuable organic manure.



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- Some characteristics and effects of farmyard manure:
 - It contains large amounts of nutrients. Only part of the nitrogen content of manure is directly available to plants, while the remaining part is released as the manure decomposes. The nitrogen in animal urine is available in the short-term.
 - When dung and urine are mixed, they form a well-balanced source of nutrients for plants. The availability of phosphorus and potassium from farmyard manure is similar to that from chemical fertilizers.



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- Chicken manure is rich in phosphorus. However, it is important to be aware of the origin of the manure, as chicken manure from conventional farms is contaminated by heavy metals. □ Organic manures contribute to the build-up of soil organic matter and thus improve soil fertility.



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Use farmyard manure & mineral fortified compost :

How to store farm yard manure:

- Farmyard manure should ideally be collected and stored for a while so as to obtain a manure of high quality. The best result is achieved if the farmyard manure is composted. Manure stored under anaerobic conditions (e.g. in water logged pits) is of inferior quality.
- Collection of farmyard manure is easiest if the animals are kept in stables. For storage, the manure should be mixed with dry plant material (straw, grass, crop residues, leaves etc.) to absorb the liquid. Straw that has been cut or mashed by spreading it out on a roadside can absorb more water than long straw.



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- Usually, the manure is stored next to the stable, either in heaps or in pits. It can also be stored within the stable as bedding, provided it is covered with fresh bedding material.
- In any case, the farmyard manure should be protected from sun, wind and rain. Water logging, as well as drying out should be avoided, so as to avoid nutrient losses.
- The storage site should be impermeable and have a slight slope. Ideally, a trench collects the liquid from the manure heap and the urine from the stable. A dam around the heap prevents uncontrolled in- and outflow of urine and water.



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- Storing manure in pits is particularly suitable for dry areas and dry seasons. Storage in pits reduces the risk of drying out and the need to water the pile.
- However, there is greater risk of waterlogging and more effort is required as the pit needs to be dug out. For this method, a 90 cm deep pit is dug with a slight slope at the bottom. The bottom is compressed and then first covered with straw.
- The pit is filled with layers about 30 cm thick and each layer compressed and covered with a thin layer of earth. The pit is filled up until it stands about 30 cm above ground and then covered with 10 cm of soil.



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- Humidity in the manure heap must be controlled. To avoid nutrient losses, it should neither be too wet nor too dry. Some indicators to monitor the humidity of the manure are:
 1. If white fungus appears (threads and white spots), the manure is too dry and should be dampened with water or urine.
 2. A yellow-green colour and/or bad smell are signs that the manure is too wet and not sufficiently aerated.
 3. If the manure shows a brown to black colour throughout the heap, the conditions are ideal



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9. Use other biomass as mulch or soil cover

10. Prepare Compost, Vermicompost & Vermiwash

COMPOST:

Composting is the process of transforming organic materials of plant or animal origin into humus in heaps or pits. Compared with uncontrolled decomposition of organic material, decomposition in the composting process occurs at a faster rate, reaches higher temperatures and results in a product of higher quality.



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- Within the process of composting, three main phases can be distinguished: the heating phase, the cooling phase and the maturing phase. However, these phases cannot be clearly separated from one another.

1. THE HEATING PHASE:

- Within 3 days of setting up the compost heap, the temperature in the heap rises to 60 to 70 °C and usually stays at this level for 2–3 weeks. Most of the decomposition occurs during the heating phase.
- In this phase, it is mainly bacteria which are active. The high temperature is a result of energy released during conversion of easily



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- Decomposable material by the bacteria. The warm temperature is a typical and important part of the composting process. The heat destroys diseases pests, weed roots and seeds.
- During this first phase of the composting process, the bacteria have a very high oxygen demand due to the rapid development of their population.
- High temperatures in the heap signal that there is an adequate supply of oxygen for the bacteria.
- If there is not enough air in the heap, bacterial development will be hindered and the compost will develop an unpleasant odour.



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- Humidity is also essential to the composting process, as bacteria require humid conditions for their work.
- The need for water is greatest during the heating phase because of high biological activity and strong evaporation occurring during this phase.
- As the heat increases, the pH of the compost heap rises (i.e. acidity decreases).



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2. THE COOLING PHASE:

- Once the material which is easily digested by the bacteria has been converted, the temperature in the compost heap declines slowly and will remain at 25–45 °C.
- With the decline in temperature, fungi settle and start the decomposition of straw, fibres and wooden material. As this decomposition process is slower, the temperature of the heap does not rise.
- As the temperature drops, the pH of the composting material declines (i.e. acidity increases).



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3. THE MATURING PHASE:

- During the maturing phase nutrients are mineralized and humic acids and antibiotics are built-up.
- Red compost worms and other soil organisms start to inhabit the heap during this phase.
- At the end of this phase the compost has lost about half of its original volume, has the colour of dark, fertile soil and is ready to use.
- The longer it is stored from now on, the more it loses its quality as a fertilizer, while its capacity to improve soil structure increases.
- In the maturing phase, the compost needs much less water than in the heating phase.



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DIFFERENT SYSTEMS AND METHODS:

Continuously fed systems:

- These systems do not heat-up during the composting process. They are handy if there is a continuous supply of wastes (e.g. kitchen waste). However, they lack the advantages of the heating phase.
- Batch-fed systems (all material is composted at once): These systems lead to a hot composting process.



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- They offer the advantages of reduced nutrient loss death of weed seeds and diseases as a result of the high temperature of composting, the process is fast (within a few weeks) and it results in a compost of superior quality.
- If little water is available, composting in pits may be more appropriate since humidity is conserved better in pits than in heaps.



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Vermicompost

- **Vermi-composting:** is a method of composting using earthworms. Earthworms speed up the composting process, aerate the organic material and enhance the finished compost with nutrients and enzymes from their digestive tracts.
- Vermicomposting allows you to create compost round the year, indoor during the winter and outdoor during the summer.



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11. Prepare dung-urine slurries

12. Prepare biodynamic inputs/compost (BD 500, BD 501, Cow Pat pit etc).



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BD 500

- Biodynamic formulation-500 (BD-500) As per the established norms of biodynamic process while cow-dung is full of astral and ethereal powers; the cow-horn shell has the potential to absorb astral powers. In this formulation the inherent potential of these two components is harvested in making a biologically active formulation.
- Method of preparation - Whip fresh cow dung to prepare a thick smooth paste. Fill the empty cow horn shells with this paste. Now place these horns facing upwards. Fill the pit with good fertile soil and compost mixture (25 : 1) till ground level.



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- The soil of the pit is to be kept moist for all the time. If required sprinkle water at repeated intervals. As per the Indian moon calendar "Kwar Navratra" (October-November) is the most ideal period for placing the dung filled horns in pits. The horns are kept buried for approximately six months and are taken out during "Chaitra Navratra" (March-April).
- Dig out the horns at appropriate time and take out the BD-500 compost. The compost should be moist and should have a pleasing smell. Store the compost in earthen pots till its use. BD-500 can be used in any crop twice, first dose is to be applied a day before sowing and second dose after 20 days of seedling emergence



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- For best results it should be applied close to full moon days. BD-500 applied during low-moon or no-moon days will not be that effective. b. Method of application – Mix 30 gm of BD-500 in about 13 lit of rain or fresh tube-well water. Stir the solution with hand for one hour.
- Apply this suspension with the help of Knapsac sprayer on soil surface or as foliar spray.
- The best time of application is close to sunset. BD-500 application encourage the growth of beneficial microorganisms and earthworms, promote rooting process and harvest terrestrial forces for better crop growth and increased biological activity in the soil.



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501 (BD-501)

- In this formulation fine powder of quartz silica is filled in empty cow-horn shells and kept buried in soil for six months during hot summer season. Opposed to BD500, the silica filled horns are buried during March-April (Chaitra Navratra) and taken out during Oct.-Nov (Kwar Navratra).
- BD-501 is used as foliar spray and is known to be promoting photosynthetic activity of the plants, resulting into better growth of the plants and better quality of grains and fruits. 1gm BD-501 is sufficient for one acre. Mix 1gm BD-501 in 13 lit of water and mix by whirling for one hour.



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- Apply this suspension in the field as fine mist spray. BD-501 should be applied in early morning hours when there is mild breeze. BD-501 is to be applied first at 3-4 leaf stage followed by two more application at an interval of 30 days.
- BD-501 also acts as prophylactic agent and helps in prevention of many fungal diseases such mildews and blights.



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Cow Pat Pit Method

- Ingredients: Bricks, Cow dung, Egg shells, Basalt dust, Gunny bag
- Dimension of the PIT
 - Length – 2 meter
 - Width – 1 meter
 - Height - 40 cm
- Time period of composting - 3-4 months



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13. Implement various soil enhancement methods effectively:

- a. Sanjivak, Jivamruth, Amritpani for microbial enrichment.
 - 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.



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Jivamruth: 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.



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- **Amrithpani:** 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.



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- b. Vermiwash, panchagavya, cattle dung urine-slurry and protein hydrolysates for growth promotion.
- Panchagavya: 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.
 - Green manuring and biomass recycling
- c. Prepare protocols for basal dose application & top dressing