CHAPTER 4: ORGANIC MANURES
MANURE

The manures are organic in nature, plant or animal origin and contain organic matter in large proportion and plant nutrients in small quantities and used to improve soil productivity by correcting soil physical, chemical and biological properties.

FERTILIZERS

"Fertilizer may be defined as materials having definite chemical composition with a higher analytical value and capable of supplying plant nutrients in available forms."
### Difference between manures and fertilizers:

<table>
<thead>
<tr>
<th>Manure</th>
<th>Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contains O.M. and hence improves soil physical properties</td>
<td>1. Do not contain O.M. and can not improve soil physical properties</td>
</tr>
<tr>
<td>2. Improves soil fertility as well as productivity</td>
<td>2. Improves soil fertility</td>
</tr>
<tr>
<td>3. Contains all plant nutrients but small in concentration</td>
<td>3. Contains one or more plant nutrients but in higher concentration</td>
</tr>
<tr>
<td>4. Required in large quantity bulky and costly</td>
<td>4. Required in less quantity concentrated and cheaper</td>
</tr>
<tr>
<td>5. Nutrients are slowly available upon decomposition</td>
<td>5. Nutrients are readily available.</td>
</tr>
<tr>
<td>6. Long lasting effect on soil and crop</td>
<td>6. Very less residual effect</td>
</tr>
<tr>
<td>7. No salt effect</td>
<td>7. Salt effect is high</td>
</tr>
<tr>
<td>8. No adverse effect</td>
<td>8. Adverse effects are observed when not applied in time and in proper proportion.</td>
</tr>
</tbody>
</table>
Characteristics of manures:

- Manure required in large quantity.
- Bulky and costly.
- Nutrients are slowly available upon decomposition.
- It has long lasting effect on soil and crop.
- No salt and adverse effect.
- Manure is organic in nature so used it is used in organic farming.
- Manures contribute to the fertility of the soil by adding organic matter and nutrients, such as nitrogen, that are trapped by bacteria in the soil.
- Higher organisms then feed on the fungi and bacteria in a chain of life that comprises the soil food web.
Classification of organic manures

Organic Manures

- Bulky organic Manures
  - Mainly derived from animal, Plant and other organic wastes and green plant tissues
  - Well decomposed Animal plant and other organic residues
- Concentrated organic Manures
  - Oil cakes meal
  - Blood meal
  - Meat meal
  - Others etc.
  - Non-edible to cattle (e.g. mahua, neem oil cakes, etc.)
  - Edible to cattle (e.g. mustard oil cake, groundnut, oil cake etc.)

Farm yard manure (FYM), composts from farm and town refuses etc.

Green manures (e.g. dhaincha, glyricidia, other leguminous crops, etc.)
Importance of organic manures

1. Organic manure binds soil particles into structural units called aggregates. These aggregates help to maintain a loose, open, granular condition. Water infiltrates and percolates more readily. The granular condition of soil maintains favorable condition of aeration and permeability.

2. Water-holding capacity is increased by organic matter. Organic matter definitely increases the amount of available water in sandy and loamy soils. Further, the granular soil resulting from organic matter additions, supplies more water than sticky and impervious soil.

3. Surface run off and erosion are reduced by organic matter as there is good infiltration.

4. Organic matter or organic manure on the soil surface reduces losses of soil by wind erosion.
5. Surface mulching with coarse organic matter lowers soil temperatures in the summer and keeps soil warmer in winter.

6. The organic matter serves as a source of energy for the growth of soil microorganisms.

7. Organic matter serves as a reservoir of chemical elements that are essential for plant growth. Most of the soil nitrogen occurs in organic combination. Also a considerable quantity of phosphorus and sulphur exist in organic forms upon decomposition, organic matter supplies the nutrients needed by growing plants, as well as many hormones and antibiotics.

8. Fresh organic matter has a special function in making soil phosphorus more readily available in acid soils.

10. Fresh organic matter supplies food for such soil life as earthworms, ants and rodents. These macro-organisms improve drainage and aeration. Earthworms can flourish only in soils that are well provided with organic matter.

11. Organic matter on decomposition produces organic acids and carbon dioxide which help to dissolve minerals such as potassium and make them more available to growing plants.

12. Humus (highly decomposed organic matter) provides a storehouse for the exchangeable and available cations – potassium, calcium and magnesium. Ammonium fertilizers are also prevented from leaching because humus holds ammonium in an exchangeable and available form.

13. It acts as a buffering agent. Buffering checks rapid chemical changes in pH and in soil reaction.
Bulky organic manures include farm yard manure (FYM) or farm manure, farm compost, town compost, night soil, sludge, green manures and other bulky sources of organic matter.

All these manures are bulky in nature and supply
(i) plant nutrients in small quantities and
(ii) organic matter in large quantities.
Farm Yard Manure (FYM):

It refers to the decomposed mixture of dung and urine of farm animals along with litter (bedding material) and left over material from roughages or fodder fed to the cattle.

On an average well rotted FYM contains 0.5% N, 0.2% $\text{P}_2\text{O}_5$ and 0.5% $\text{K}_2\text{O}$. 
Average percentage of N, P$_2$O$_5$ and K$_2$O in the fresh excreta of farm animals:

<table>
<thead>
<tr>
<th>Excreta of</th>
<th>N (%)</th>
<th>P$_2$O$_5$ (%)</th>
<th>K$_2$O (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows and bullocks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dung</td>
<td>0.40</td>
<td>0.20</td>
<td>0.10</td>
</tr>
<tr>
<td>Urine</td>
<td>1.00</td>
<td>Traces</td>
<td>1.35</td>
</tr>
<tr>
<td>Sheep and goat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dung</td>
<td>0.75</td>
<td>0.50</td>
<td>0.45</td>
</tr>
<tr>
<td>Urine</td>
<td>1.35</td>
<td>0.05</td>
<td>2.10</td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dung</td>
<td>0.26</td>
<td>0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>Urine</td>
<td>0.62</td>
<td>Traces</td>
<td>1.61</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>1.46</td>
<td>1.17</td>
<td>0.62</td>
</tr>
</tbody>
</table>

- Poultry manure is the richest of all
- Urine of all animals contains more percentage of N and K$_2$O compared to the dung portion.
Factors Affecting Nutritional Build up of FYM:

The following factors affect the composition of FYM:

1. Age of animal
2. Feed
3. Nature of Litter Used
4. Ageing of Manure
5. Manner of Making and Storage
Losses during handling and storage of FYM:

A. Losses during handling:

FYM consists of two original components the solid or dung and liquid or urine. Both the components contain N, P$_2$O$_5$ and K$_2$O the distribution of these nutrients in the dung and urine is shown in below:

Approximately half of N and K$_2$O is in the dung and the other half in urine. By contrast, nearly all of the P$_2$O$_5$ (96%) is in the solid portion.

To conserve N, P$_2$O$_5$ and K$_2$O, it is most essential that both the parts of cattle manure are properly handled and stored.
i) **Loss of liquid portion or urine**

Under Indian conditions the floor of the cattle shed is usually un-cemented or Kachha. As such the urine passed by animals during night gets soaked into the Kachha floor.

When the animals, particularly bullocks, are kept in the fields during the summer season, urine gets soaked into soil. But during remaining period cattle are kept in a covered shed and therefore the Kachha floor soaks the urine every day.

Large quantities of nitrogen are thus lost through the formation of gaseous $\text{NH}_3$. The following reactions take place:
NH₂CO NH₂ + 2H₂O \rightarrow (NH₄)₂CO₃
Urea in urine

(NH₄)₂ CO₃ + 2H₂O \rightarrow 2NH₄OH + H₂ CO₃
Ammonium carbonate

NH₄OH \rightarrow NH₃↑ + H₂O
Gaseous Ammonia

- The smell of NH₃ in the cattle shed clearly indicates the loss of N.
- No special efforts are made in India to collect the liquid portion of the manure.
ii) Loss of solid portion or dung

It is often said that $2/3$ of the manure is either utilized for making cakes or is lost during grazing, the remaining manure is applied to the soil after collecting in heaps.

- Firstly, the most serious loss of dung is through cakes for burning or for use as fuel-
- Secondly, when milch animals go out for grazing, no efforts are made to collect the dung dropped by them, nor is this practicable, unless all milch animals are allowed to graze only in enclosed small size pastures.
B. Loss during storage:

Mostly, cattle dung and waste from fodder are collected daily in the morning by the cultivators and put in manure heaps in an open space outside the village. The manure remains exposed to the sun and rain. During such type of storage, nutrients are lost in the following ways:

i) By leaching:
Losses by leaching will vary with the intensity of rainfall and the slope of land on which manure is heaped. About half of portion of N and P$_2$O$_5$ of FYM and nearly 90% of K are water soluble. These water soluble nutrients are liable to get washed off by rain water.

ii) By Volatilization:
During storage considerable amount of NH$_3$ is produced in the manure heap from the decomposition of urea and other nitrogenous compounds of the urine and the much slower decomposition of the nitrogenous organic compounds of the dung. As the rotting proceeds, more and more quantity of ammonia is formed. This NH$_3$ combines with carbonic acid to form ammonium carbonate and bicarbonate. These ammonium compounds are unstable and gaseous NH$_3$ may be liberated as indicated below:
Improved Methods of Handling FYM:

It is practically impossible to check completely the losses of plant nutrients and organic matter during handing and storage of FYM. However, improved methods could be adopted to reduce such losses considerably. **Among these methods are described here under:**

- Trench method of preparing FYM
- Use of gobar gas-compost plant
- Proper field management of FYM
- Use of chemical preservatives
i) Trench method of preparing FYM:

This method has been recommended by Dr. C. N. Acharya. The manure preparation should be carried out in trenches, having size of 20 to 25 ft. long, 5 to 6 ft. broad and 3 to 3.5 ft. deep.

Cattle shed and portions of litter mixed with earth if available. When trench is completely filled up, say in about three months time.
ii) Use of gobar gas compost plant:
Methane gas is generated due to anaerobic fermentation of the most common organic materials such as cattle dung, grass, vegetable waste and human excreta. Gobar gas and manure both are useful on farms as well as in homes. A few advantages of this method are given below:

1) The methane gas generated can be used for heating, lighting and motive power.
2) The methane gas can be used for running oil engines and generators
3) The manure which comes out from the plant after decomposition is quite rich in nutrients. N-1.5%, P$_2$O$_5$- 0.5%, K$_2$O- 2.0%
4) Gobar gas manure is extremely cheap and is made by locally available materials.
iii) Proper field management of FYM:

Under field conditions, most of the cultivators unload FYM in small piles in the field before spreading. The manure is left in piles for a month or more before it is spread. Plant nutrients are lost through heating and drying.

To derive maximum benefit from FYM, it is most essential that it should not be kept in small piles in the field before spreading, but it should be spread evenly and mixed with the soil immediately.
iv) **Use of Chemical Preservatives:**

Chemical preservatives are added to the FYM to decrease N losses. To be most effective, the preservatives are applied in the cattle yard to permit direct contact with the liquid portion of excreta or urine. This has to be done because the **loss of N from urine starts immediately**. The commonly used chemical preservatives are **I) Gypsum and II) Super phosphate**.

The value of gypsum in preserving the N of manure has been known and it has been used for many years in foreign countries. The reaction of gypsum with ammonium carbonate (intermediate product from decomposition of urea present in urine) is:

\[
(NH_4)_2 CO_3 + CaSO_4 \rightarrow CaCO_3 + (NH_4)_2 SO_4
\]

As long as the manure is moist, no loss of NH₃ will occur, but if the manure becomes dry, the chemical reaction is reversed and the loss of NH₃ may occur. As such, under Indian conditions, use of gypsum to decrease N losses, does not offer a practical solution.

Superphosphate has been extensively used as a manure preservative:

\[
2CaSO_4 + Ca(H_2PO_4)_2 + 2(NH_4)_2 CO_3 \rightarrow Ca_3(PO_4)_2 + 2(NH_4)_2 SO_4 + 2H_2O + 2CO_2
\]

In this reaction, tricalcium phosphate is formed which does not react with ammonium sulphate, when manure becomes dry. As such, there is no loss of NH₃.
Supply of plant nutrients through FYM:

On an average, FYM applied to various crops by the cultivators contains the following nutrients:

\[
\begin{align*}
\% \text{ N} & : 0.5 \\
\% \text{ P}_2\text{O}_5 & : 0.2 \\
\% \text{ K}_2\text{O} & : 0.5
\end{align*}
\]

Based on this analysis, an average dressing of 10 tones of FYM supplies about

50 Kg N, 20 Kg P\textsubscript{2}O\textsubscript{5} and 50 Kg K\textsubscript{2}O

All of these quantities are not available to crops in the year of application, particularly N which is very slow acting.

When FYM is applied every year, the crop yield goes on increasing due to direct plus residual effect on every succeeding crop. The beneficial effect is also known as cumulative effect.
Compost:

- Compost consists of organic materials derived from plant and animal matter that has been decomposed largely through aerobic decomposition.
- The process of composting is simple and practiced by individuals in their homes, farmers on their land, and industrially by industries and cities.
- Composting is largely a bio-chemical process in which microorganisms both aerobic and anaerobic decompose organic residue and lower the C:N ratio.
- The final product of composting is well-rotted manure known as compost.

Rural compost: Compost from farm litters, weeds, straw, leaves, husk, crop stubble, bhusa or straw, litter from cattle shed, waste fodder, etc. is called rural compost.

Urban compost: Compost from town refuse, night soil and street dustbin refuse, etc. is called urban compost.
Composition of town compost:

<table>
<thead>
<tr>
<th>Nitrogen (%N)</th>
<th>Phosphorus (%P$_2$O$_5$)</th>
<th>Potassium (%K$_2$O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>1.0</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Decomposition:

- The dung and litter have to be fermented or decomposed before they become fit for use. Hence, the material is usually stored in heaps or pits, where it is allowed to decompose. **Under suitable conditions of water supply, air, temperature, food supply and reaction,** the microorganisms decompose the material.

- The decomposition is **partly aerobic and partly anaerobic.**

- During decomposition the usual **yellow or green colour** of the litter is changed to **brown** and ultimately to dark brown or black colour; its structural form is converted into a colloidal, slimy more or less homogenous material, commonly known as **humus.**

- A well decomposed manure has a typical **black colour** and a loose friable condition. It does not show the presence of the original **litter or dung.**
Factors controlling process of decomposition:

1) Food supply to micro-organisms and C : N ratio:
   The suitable ratio of carbonaceous to nitrogenous materials is 40, if it is wider than this, the decomposition takes place very slowly and when narrow it is quick. C:N ratio of the dung of farm animals varies from 20 to 25, urine 1 to 2, poultry manure 5-10, litters-cereals straw 50, and legume refuse 20.

2) Moisture:
   About 60-70 per cent moisture is considered to be the optimum requirement to start decomposition and with the advance in decomposition, it diminishes gradually being 30-40 per cent in the final product.

   Excess of moisture prevents the temperature form rising high and retards decomposition, resulting in loss of a part of the soluble plant nutrients through leaching and drainage.

   In the absence of sufficient moisture, microbial activity ceases and the decomposition practically comes to an end.
3) **Aeration:**

Most of the microbial processes are oxidative and hence a free supply of oxygen is necessary.

**Reasons for poor aeration in pit/heap**

- Excessive watering
- Compaction
- Use of large quantities of fine and green material as litters
- High and big heaps or deep pits.

4) **Temperature:**

Under the optimum conditions of air, moisture and food supply, there is a rapid increase in the temperature in the manure heap or pit. The temperature usually rises to **50° – 60°C and even to 70°C**.

The high temperature destroys **weed seeds, worms, pathogenic bacteria**, etc; which prevents **fly breeding** and makes the manure safe from hygienic point of view.
## Heap V/S Pit decomposition:

<table>
<thead>
<tr>
<th>Heap</th>
<th>Pit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerobic</td>
<td>1. Anaerobic</td>
</tr>
<tr>
<td>2. Turning is required</td>
<td>2. No turning is required</td>
</tr>
<tr>
<td>3. Physical disintegration</td>
<td>3. Very little physical disintegration</td>
</tr>
<tr>
<td>4. Quick oxidation</td>
<td>4. Slow rate of decomposition</td>
</tr>
<tr>
<td>5. High temp. 60° – 70°C. Kill weed seeds and pathogenic organisms</td>
<td>5. High temp. is not developed but weed seeds and MO destroyed due to toxic products of decomposition.</td>
</tr>
<tr>
<td>6. Loss of OM is about 50%</td>
<td>6. Loss is about 25%</td>
</tr>
<tr>
<td>7. If not properly protected, moisture loss is high. Watering is necessary</td>
<td>7. Moisture loss is minimized. No watering is necessary</td>
</tr>
<tr>
<td>8. If rainfall is high, leaching takes place</td>
<td>8. Protected form leaching but anaerobic condition occurs.</td>
</tr>
</tbody>
</table>
Vermicomposting:

Vermicompost is the product of composting utilizing various species of worms, usually red wigglers, white worms, and earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast.

Vermicast is also known as worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by species of earthworm.

The earthworm species (or composting worms) most often used are Red Wigglers (*Eisenia foetida* or *Eisenia andrei*), though European nightcrawlers (*Eisenia hortensis*) could also be used. Users refer to European night crawlers by a variety of other names, including *dendrobaenias*, *dendras*, and Belgian nightcrawlers. Containing water-soluble nutrients, vermicompost is a nutrient-rich organic fertilizer and soil conditioner.
Vermiculture means artificial rearing or cultivation of worms (Earthworms). Vermicompost is the excreta of earthworm, which is rich in humus. Earthworms eat cow dung or farm yard manure along with other farm wastes and pass it through their body and in the process convert it into vermicompost.
Method of preparation of Vermicompost
Large/community Scale

A thatched roof shed preferably open from all sides with unpaved (katcha) floor is erected in East-West direction length wise to protect the site from direct sunlight.

A shed area of 12’X12’ is sufficient to accommodate three vermicibeds of 10’X3’ each having 1’ space in between for treatment of 9-12 quintals of waste in a cycle of 40-45 days.

The length of shed can be increased/decreased depending upon the quantity of waste to be treated and availability of space.

The height of thatched roof is kept at 8 feet from the centre and 6 feet from the sides. The base of the site is raised at least 6 inches above ground to protect it from flooding during the rains. The vermicibeds are laid over the raised ground as per the procedure given below.
The site marked for **vermibeds** on the raised ground is **watered** and a 4”-6” layer of any slowly biodegradable agricultural residue such as dried leaves/straw/sugarcane trash etc. is laid over it after soaking with water. This is followed by 1” layer of vermicompost or farm yard manure.

Earthworms are released on each vermibed at the following rates:

*For treatment of cowdung/agriwaste*: 1.0 kg. per vermibed  
*For treatment of household garbage*: 1.5 kg. per vermibed
Multiplication of worms in large scale:

Prepare a mixture of cow dung and dried leaves in 1:1 proportion.
Release earthworm @ 50 numbers/10 kg. of mixture and mix dried grass/leaves or husk and keep it in shade.
Sprinkle water over it time to time to maintain moisture level.
By this process, earthworms multiply 300 times within one to two months.
These earthworms can be used to prepare vermicompost.
Advantages of Vermicomposting:

- Vermicompost is an ecofriendly natural fertilizer prepared from biodegradable organic wastes and is free from chemical inputs.
- It does not have any adverse effect on soil, plant and environment.
- It improves soil aeration, texture and tilth thereby reducing soil compaction.
- It improves water retention capacity of soil because of its high organic matter content.
- It promotes better root growth and nutrient absorption.
- It improves nutrient status of soil—both macro-nutrients and micro-nutrients.
Precautions during vermicomposting:

- Vermicompost pit should be protected from direct sun light.
- To maintain moisture level, spray water on the pit as and when required.
- Protect the worms from ant, rat and bird.
Nutrient Profile of Vermicompost and Farm Yard Manure:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Vermicompost</th>
<th>Farm Yard Manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>1.6</td>
<td>0.5</td>
</tr>
<tr>
<td>P (%)</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>K (%)</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Ca (%)</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Mg (%)</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Fe (ppm)</td>
<td>175.0</td>
<td>146.5</td>
</tr>
<tr>
<td>Mn (ppm)</td>
<td>96.5</td>
<td>69.0</td>
</tr>
<tr>
<td>Zn (ppm)</td>
<td>24.5</td>
<td>14.5</td>
</tr>
<tr>
<td>Cu (ppm)</td>
<td>5.0</td>
<td>2.8</td>
</tr>
<tr>
<td>C:N ratio</td>
<td>15.5</td>
<td>31.3</td>
</tr>
</tbody>
</table>
Night Soil:

- Night soil is human excrement i.e. solid and liquid.
- Night soil is richer in $N$, $P_2O_5$ and $K_2O$ as compared to FYM or compost. On oven dry basis, it has an average chemical composition of:
  - $N\%$: 5.5
  - $P_2O_5\%$: 4.0
  - $K_2O\%$: 2.0
- In India it is applied to a limited extent directly to the soil.
Sewage and Sludge:

In the modern system of sanitation adopted in cities, water is used for the removal of human excreta and other wastes. This is called the sewage system of sanitation. In this system, there is a considerable dilution of the material in solution and in dispersion in fact, water is the main constituent of sewage, amounting often to 99.0%.

In general sewage has two components, namely

- Solid portion, technically known as sludge and
- Liquid portion, commonly known as sewage water.

Both the components are used in increasing crop production as they contain plant nutrients.
Green Manuring:

Practice of incorporating undecomposed green plant tissues into the soil for the purpose of improving physical structure as well as fertility of the soil.

In agriculture, a green manure is a type of cover crop grown primarily to add nutrients and organic matter to the soil.

Typically, a green manure crop is grown for a specific period, and then plowed under and incorporated into the soil.

Green manures usually perform multiple functions that include soil improvement and soil protection:
Types of green manuring:

Broadly two types of green manuring can be differentiated.

i. Green manuring *in situ* and

ii. Green leaf manuring

i) Green manuring *in situ*:

In this system green manure crops are grown and buried in the *same field*, either as a pure crop or as intercrop with the main crop.

The most common green manure crops grown under this system are *Sannhemp*, *dhaincha* and *guar*. 
ii) Green leaf manuring:

Green leaf manuring refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, waste lands and nearby forest areas.

The common shrubs and trees used are Glyricidia, Sesbania (wild dhaincha), Karanj, etc.

The former system is followed in northern India, while the latter is common in eastern and central India.
Advantages of Green Manuring:

1. It **adds organic matter** to the soil. This stimulates the activity of soil micro-organisms.
2. Green manure crops return to the upper top soil, plant nutrients taken up by the crop from **deeper layers**.
3. It improves the **structure** of the soil.
4. It facilitates the **penetration of rain water** thus decreasing run off and erosion.
5. The green manure crops **hold plant nutrients** that would otherwise be lost by leaching.
6. When leguminous plants, like sannhemp and dhaincha are used as green manure crops, they **add nitrogen to the soil** for the succeeding crop.
7. It increases the availability of certain plant nutrients like **phosphorus, calcium, potassium, magnesium and iron**.
Disadvantages of green manuring:

When the **proper technique** of green manuring is not followed or when **weather conditions** become unfavourable, the following disadvantages are likely to become evident.

1. Under rainfed conditions, it is feared that **proper decomposition** of the green manure crop and satisfactory germination of the succeeding crop may not take place, if sufficient rainfall is not received after burying the green manure crop.

2. Since green manuring for wheat means **loss of kharif crop**, the practice of green manuring may not be always economical.

3. In case the main advantage of green manuring is to be derived from addition of nitrogen, the **cost of growing green manure crops** may be more than the cost of commercial nitrogenous fertilizers.

4. An increase of **diseases, insects and nematodes** is possible.

5. A risk is involved in obtaining a satisfactory stand and growth of the green manure crops, if sufficient rainfall is not available.
Green manure crops:

<table>
<thead>
<tr>
<th>Leguminous</th>
<th>Non-leguminous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sannhemp</td>
<td>1. Bhang</td>
</tr>
<tr>
<td>2. Dhaincha</td>
<td>2. Jowar</td>
</tr>
<tr>
<td>5. Guar</td>
<td></td>
</tr>
<tr>
<td>6. Senji</td>
<td></td>
</tr>
<tr>
<td>7. Khesari</td>
<td></td>
</tr>
<tr>
<td>8. Berseem</td>
<td></td>
</tr>
</tbody>
</table>
**Selection of Green manure crops *in situ*:  

Certain green manure crops are suitable for certain parts of the country. Suitability and regional distribution of important green manure crops are given below:  

**Sannhemp**: This is the most outstanding green manure crop. It is well suited to *almost all parts of the country*, provided that the area receives sufficient rainfall or has an assured irrigation. It is extensively used with sugarcane, potatoes, garden crops, second crop of paddy in South India and irrigated wheat in Northern India.  

**Dhaincha**: It occupies the *second place* next to sannhemp for green manuring. It has the advantage of growing under *adverse conditions of drought, water-logging, salinity and acidity*. It is in wide use in Assam, West Bengal, Bihar and Chennai with sugarcane, Potatoes and paddy.  

**Guar**: It is well suited in areas of *low rainfall and poor fertility*. It is the most common green manure crop in Rajasthan, North Gujarat and Punjab.
Thanks