

Crops and major soils - Classification – Economic and agricultural importance in India and Tamil Nadu

CROPS

In general, crop is an organism grown and / or harvested for obtaining yield. Agronomically, crop is a plant cultivated for economic purpose.

Classification of crops

Classification is done to generalize similar crop plants as a class for better understanding of them.

Classification types used in crops

1. Based on ontogeny (Life cycle)
2. Based on economic use (Agronomic)
3. Based on Botany (Scientific)
4. Based on seasons
5. Based on climate

1. Based on Ontogeny (Life cycle)

a) Annual crops:

Crop plants that complete life cycle within a season or year. They produce seed and die within the season. Ex. Wheat, rice, maize, mustard etc.

b) Biennial crops:

Plants that have life span of two consecutive seasons or years. First years/ season, these plants have purely vegetative growth usually confined to rosette of leaves. The tap root is often fleshy and serves as a food storage organ. During the second year / season, they produce flower stocks from the crown and after producing seeds the plants die. Ex. Sugar beet, beet root, etc.

c) Perennial crops:

They live for three or more years. They may be seed bearing or non-seed bearing. Ex. Napier fodder grass, coconut, etc.

2. Based economic use (Agronomic)

a) **Cereals:** Cereal derived from word 'Ceres' which denotes as 'Goddess' who was believed as the giver of grains by Romans. Cereals are the cultivated grasses grown for their edible starchy grains. Larger grains used as staple food – Rice, wheat, maize, barley, oats etc.

Cereal grain contains 60 to 70% of starch and is excellent energy rich foods for humans. In almost every country and region, cereals provide the staple food. In the world as a whole, only 5% of starchy staple food comes from root crops (mainly cassava, potato, and yams, depending on climate), whereas the rest is from cereal. Cereals are an excellent source of fat soluble vitamin E, which is an essential antioxidant. Whole cereal grains contain 20 to 30% of the daily requirements of the minerals such as selenium, calcium, zinc and copper.

b) Millets:

Millets are small grained cereals, staple food in drier regions of the developing countries are called 'millets'. They are also annual grasses of the group cereals. But they are grown in lesser area or less important area whose productivity and economics are also less important. These are also staple food for people of poor countries. In India, pearl millet is a staple food in Rajasthan.

Millets are broadly classified in to two, 1) Major millets and 2) Minor millets.

Major millets

- | | |
|------------------------------|-----------------------------|
| 1. Sorghum /Jowar/Cholam | - <i>Sorghum bicolor</i> |
| 2. Pearl millet /Bajra/Cumbu | - <i>Pennisetum glaucum</i> |
| 3. Finger millet or Ragi | - <i>Eleusine coracona</i> |

Minor millets

- | | |
|----------------------------|--------------------------|
| 1. Foxtail millet / Thenai | - <i>Setaria italica</i> |
| 2. Little millet / Samai | - <i>Panicum miliare</i> |

3. Common millet / *Panivaraugu* - *Panicum miliaceum*
4. Barnyard millet / *Kudiraivali* - *Echinochloa colona var frumentaceae*
5. Kodo millet / *Varagu* - *Paspalum scrobiculatum*

c) Pulses:

Seeds of leguminous plants used as food (*Dhal*) rich in protein. Pod containing grain is the economic portion. Pulses are preferred for protein rich value & also economic important in cropping system. The wastes or stalk is called the 'hulm' or 'stover'. Hulm is used as green manure and has high value cattle feed. Green pods used as vegetables, e.g. cowpea, lablab. Seed coat of pulses are nutritious cattle feed.

1. Red gram - *Cajanus cajan*
2. Black gram - *Vigna mungo*
3. Green gram - *V. radiata*
4. Cowpea - *V. unguiculata*
5. Bengalgram - *Cicer arietinum*
6. Horsegram - *Macrotyloma uniflorum*
7. Lentil - *Lens esculentus*
8. Soybean - *Glycine max*
9. Peas or gardenpea - *Pisum sativum*
10. Garden bean - *Lablab purpureus*
11. *Lathyrus/Kesari* - *Lathyrus sativus*

d) Oil seeds: Those crops which are rich in fatty acid are cultivated for the production of vegetable oil. They are used either for edible or industrial or medicinal purposes.

1. Groundnut or peanut - *Arachis hypogaeae*
2. Sesame or gingelly - *Sesamum indicum*
3. Sunflower - *Helianthus annuus*
4. Castor - *Ricinus communis*
5. Linseed or flax - *Linum usitatissimum*
6. Niger - *Guizotia abyssinia*
7. Safflower - *Carthamus tinctorius*
8. Rapeseed & Mustard
Brown or Indian Mustard - *Brassica juncea*
9. Sarson - *Brassica sp.*

Groundnut:

Pod is economic portion in groundnut and contains 50% of oil content. Oil is edible or cooking oil and hulm is a used as cattle feed and also has manure value. The shell has fuel value; it is used for soil amendment. It is a bed material in the poultry forms. Oil cake is used as cattle feed and has manural value. Oil is used for production of *Vanaspathi* and soap making.

Sesame:

Sesame oil is cooking oil and economic parts are generally seeds (in the pod). Gingelly cake is used as a cattle feed, whereas capsule and stalk are used for composting / burning purpose.

Castor:

Seed (kernal) of castor contains oil and used as medicinal and industrial oil. Mainly aviation industries use this for lubrication purpose. Castor cake is concentrated organic manure. The shell and stalk is used for fuel purpose.

Mustard:

Mustard oil is edible oil and seeds are the economic portion. Oil cake is a good cattle feed.

Safflower and sunflower:

Oil is used for cooking purpose. Both of these oils contain more of unsaturated fatty acids and used for heart patients. Cake is used as cattle feed and also organic material and decorticated manure.

Niger:

Seed is the economic portion and used in soap making, paint, varnish & light lubricant. Crop is generally an industrial crop.

Linseed:

Oil extracted from seeds is used in preparation of paints and varnishes.

e. Sugar crops

Crops cultivated for sugar. Juice is extracted from stem of sugarcane used for jaggery or sugar. Number of by products like molasses, bagasse, pressmud etc. is obtained from sugar industry. Molasses used for alcohol and yeast formation and bagasse for paper making and fuel. Pressmud used for soil amendment; whereas, trash (green leaf + dry foliage) is used for cattle feed.

Sugar beet is another sugar crop where tubers are mainly used for extraction of sugar. Tubers and tops are used as a fodder for cattle feed.

1. Sugarcane - *Saccharum officinarum*
2. Sugar beet - *Beta vulgaris*

f) Fibre crops:

Plants are grown for obtaining fibre. Different kinds of fibre are, i) seed fibre – cotton; ii) Stem/ bast fibre – Jute, mesta; iii) leaf fibre – *Agave*, pineapple.

Cotton:

Important fibre crop of the world, used for garment purpose. Seed for cattle feed and oil is edible purpose. Epidermal hairs of seed coats is the economic portion. Lint (*Kapas*-seed) has industrial value (fibre) and stalk is of fuel nature.

Jute, *Sunnhemp*, mesta:

The fibre obtained from stems is used for gunny bags, ropes. Stem itself is used as fuel. *Sunnhemp* is used for both stem fibre and green manure crop.

g) Fodder / Forage: It refers to vegetative matter, fresh or preserved, utilized as feed for animals. It includes hay, silage, pasturage and fodder.

- Ex. 1. Grasses - *Bajra napier* grass, guinea grass, fodder sorghum, fodder maize.
 2. Legumes - Lucerne, *Desmanthus*, etc.

h) Spices and condiments: Crop plants or their products used for flavour, taste and add colour to the fresh or preserved food. Ex.– Ginger, garlic, fenugreek, cumin, turmeric, chillies, onion, coriander, anise and asafetida.

i) Medicinal plants: Crops used for preparation of medicines. Ex. Tobacco, mint. etc.

j) Beverages: Products of crops used for preparation of mild, agreeable and simulating drinking. Ex. Tea, coffee, cocoa (Plantation crops).

3. Scientific or botanical classification

Botanical or scientific names of plants which consist of genus and species and are universally accepted. Carolus Linnaeus, a Swedish botanist, was responsible for the binomial system of classification.

Group	Grass (Wheat)	Legume (Alfalfa)
Kingdom	Plant	Plant
Division	Spermatophyta	Spermatophyta
Sub-division	Angiospermae	Angiospermae
Class	Monocotyledonae	Dicotyledonae
Order	Graminales	Rosales
Family	Gramineae	Leguminosae

Tribe	Hordeae	-
Genus	<i>Triticum</i>	<i>Medicago</i>
Species	<i>aestivum</i>	<i>sativa</i>

4. Based on seasons

Crops are grouped under the seasons in which their major field duration falls.

a) Kharif crops: Crops grown during June-July to September–October which require a warm wet weather during their major period of growth and shorter day length for flowering.

Ex. Rice, maize, castor, groundnut.

b) Rabi crops: Crops grown during October–November to January-February, which require cold dry weather for their major growth period and longer day length for flowering.

Ex. Wheat, mustard, barley, oats, potato, bengal gram, berseem, cabbage and cauliflower.

c) Summer crops: Crops grown during February–March to May–June which require warm dry weather for growth and longer day length for flowering. Ex. Black gram, greengram, sesame, cowpea etc.

This classification is not a universal one. It only indicates the period when a particular crop is raised. Ex. *Kharif* rice, *kharif* maize, *rabi* maize, summer pulse etc.

5. Based on climatic condition

- 1) Tropical crop : Coconut, sugarcane
- 2) Sub-tropical crop : Rice, cotton
- 3) Temperate crop : Wheat, barley
- 4) Polar crop : All pines, pasture grasses

SOILS

Soil is defined as the thin layer of earth's crust made up of disintegrated and decomposed rocks, complex mineral compound, organic matter, water/air and living organism like bacteria, fungi, insects and worms and serves as the natural medium of growth of plants.

It provides nutrients, moisture, anchorage (support) and provides air to root system. There are different soil groups found in varied regions of India. Each group differs from other in physical and chemical properties. The variation in behaviour is mainly due to the nature of the parent material from which the soils are formed. Parent materials are Igneous rocks, sedimentary rocks and metamorphic rocks. Physical properties like structure, texture, colour, water holding capacity, depth etc. are to be noted. Chemical properties like the presence of various plant elements, pH, EC, CEC, acidic or alkaline, etc. are considered.

Classification based on soil taxonomy

- | | | | |
|-------------|--|----------|----------------------|
| Order | : <i>Entisols</i> | Suborder | : Fluvents |
| Great Group | : Torrifuvents | Subgroup | : Typic Torrifuvents |
| Family | : Fine-loamy, mixed, superactive, calcareous, Typic Torrifuvents | | |
| Series | : Jocity, Youngston. | | |

Major soils of India

1. Alluvial soil (*Entisols, Inceptisols and Alfisol*)
2. Black soil (*Vertisol*)
3. Red soil (*Alfisol*)
4. Laterite soil (*Ultisol*)
5. Desert soil (*Aridisol*)
6. Forest soil and hill soil, peat and marshy soils
7. Problem soils (saline, alkali, acid)

1. Alluvial soil or Indo-Gangetic Alluvium

This is the most extensive soil found in India. Out of total area of India, 48.0 m.ha comes under river alluvium. These soils include deltaic alluvium, calcareous alluvium and coastal

alluvium. Alluvial soils are formed by transportation in streams and rivers and are deposited in flood plains or along the coastal belts. Newly formed alluvium may not have distinct soil horizons while older alluvium may have soil horizons. They occur in the basins of Indus, Ganges, Brahmaputra, Godavari, Krishna, Cauvery and Tambiraparani deltas spread in U.P., Bihar, West Bengal, Gujarat, Punjab, Rajasthan, Andhra Pradesh, Tamil Nadu.

Newer alluvium is called as *Khadar*, is sandy, light colour and less *Kankar* nodules. Older alluvium is called as *Bhangar*, full of clay, dark colour and more *Kankar* nodules. Alluvial soils of high altitude are acidic in nature and plains are neutral to alkaline. Alluvial soils of plains are medium in phosphorous content and high in potassium content. Generally, alluvial soils are rich in nutrients and are fertile and they support good crop growth with plenty of water. Many crops including vegetable are cultivated in river alluvium. Crops like rice, wheat, cotton, maize, sugarcane, vegetables, jute, oil seeds, millets, pulses and fruits are cultivated in these soil.

2. Black soil

Dark-grey in colour due to clay-humus complex. Area around 32.0 m.ha is under this soil. This soil is also called black cotton soil, mixing of soil along the entire column with *Montmorillonite* clay. Cotton grows very well with water available in soil. Black soil holds more moisture and available for a long time. Found in Maharashtra, Madhya Pradesh, South Orissa, South and Coastal Andhra Pradesh, North Karnataka and parts of Tamil Nadu. Black soil contains high proportion of clay (30-40%), so, the water holding capacity is high. Typical characteristics of this black soil are swelling (during wet period) and shrinkage (dry period). While dry, it forms very deep cracks of more than 30-45 cm. In Kovilpatti (Tamil Nadu) areas the cracks may extend to 2 to 3 m with a width of 1 to 6 cm. Field preparation takes longer time compared to other soil. Only after secondary tillage, the soil is suited for crop production. The soils are fine grained contain high proportion of Calcium and Magnesium carbonates. They are poor in N, medium in P and medium to high in K (Characteristic feature of typical Indian soil).

In Tamil Nadu Black soils have high pH (8.5 to 9) and are rich in lime (5-7%), have low permeability. The soils are with more cation exchange capacity (40-60 m.e./100 g). Crops grown in this soil are cotton, bengal gram, mustard, millets, pulses, oil seeds (sunflower, safflower) are commonly grown in this soil. Most of the soils come under rainfed areas.

3. Red soil

Based on the colour (due to presence of ferric oxides) it is called as red soil. Around 30 m.ha are found in India. They are formed from granites and other metamorphic rocks. Mostly found in semi-arid areas and the colour varies from red to yellow. The soil is light textured, with *Kaolinite* type of clay. Well drained with moderate permeability. Low cation exchange capacity and low water holding capacity. Red soil is present in Gujarat, Tamil Nadu, Karnataka, Andhra Pradesh, North and East of Arunachal Pradesh, Madhya Pradesh, Parts of Bihar and Uttar Pradesh. They are shallow in depth because they are degraded or drained soil. Lesser clay and more sandy than *Vertisol*. Red soil is always in acidic nature. Highly suitable for groundnut crop cultivation. Crops like millets, pulses, oil seeds (ground nut, gingelly, castor) and tuber crops like cassava are commonly cultivated.

4. Laterites and Lateritic soil

Laterite soils are formed due to the process of laterisation. i.e., leaching of all cations leaving Fe and Al oxides. Mostly found in hills and foothill areas. This soil is formed under high intensive down pour of rainfall. It is modified form of red soil, clay content is minimum. Rich in organic matter content and rich in fertility and medium water holding capacity. They become very hard when there is no water. The cohesive nature is high. Acid loving crops (Plantation crops) and fruits (pineapple, avacado) are more cultivated. Tea, rubber, pepper, spices are cultivated. At lower elevation places, rice is grown.

5. Desert soil

Found in desert regions of Rajasthan (Thar desert), parts of Haryana and Punjab of India. More sand is found and sand dunes are common. Clay content is < 8% only. Poor fertility, poor water holding capacity and susceptible to soil erosion. Presence of sodic salts (high Na content) leads to alkalinity. Crops like date palm, cucumber, millets are cultivated (countries like Saudi Arabia, UAE, Jordan, Sudan etc).

6. Peaty and Organic soil

These soils are very rich in organic matter. Found in Kerala, coastal regions of West Bengal, Orissa, South and East coast of Tamil Nadu. Deposition of organic matter by the elevated soil. Peaty and organic soil is not suitable for majority of crops. Rice is mostly cultivated in coastal area in rainy season.

7. Problem soil

Saline soils: Contain excess amounts of neutral soluble salts dominated by chlorides and sulphates of Na, Ca and Mg affects plant growth. White encrustation of salts and hence called white alkali. These soils are characterized by, EC: 4dSm^{-1} at 25°C , ESP: < 15; pH; < 8.5. This soil needs leaching and drainage before cropping for amelioration.

- i) High salt tolerant: *Sesbania*, Rice, sugarcane, oats, berseem, lucerne, indian clover & barley.
- ii) Medium salt tolerant: Castor, cotton, sorghum, pearl millet, maize, mustard & wheat.
- iii) Low salt tolerant: Pulses, peas, *Sunnhemp*, gram, linseed and sesame.

Sodic / Alkali soils: High content of carbonates and bicarbonates of Na. Hence, they are with high exchangeable sodium percentage (ESP) with dark encrustation, hence called as black alkali. These soils are rich in NaHCO_3 and characterized by pH: > 8.5; EC : < 4dSm^{-1} ; ESP : > 15. Use gypsum ($\text{CaSO}_4, 2\text{H}_2\text{O}$) as amendment for reclamation of sodic alkali soils. Iron pyrites (FeS_2), bulky organic manures (especially green manure) and crop residues which produces weak organic acids.

- i) Tolerant crops: Karnal / rhodes / para/ bermuda grass, rice and sugar beet.
- ii) Semi-tolerant: Wheat, barley, oats, berseem and sugarcane.
- iii) Sensitive: Cowpea, gram, groundnut, lentil, peas and maize.

Acid soils: These are low pH with high amounts of exchangeable H^+ and Al_3 . Occur in regions with high rainfall. Significant amount of partly decomposed organic matter exist. Have low CEC and high base saturation. Liming and judicious use of fertilizers are the management measures suggested. Suitable crops: Acedophytes (like potato).

Comparison of three types of soils

Parameters	Saline soil	Saline alkali	Alkali soil
EC (dS/m)	>4	>4	<4
ESP (%)	<15	>15	>15
pH	<8.5	<8.5	>8.5

Soils of Tamil Nadu

Type of Soil	Areas in Tamil Nadu
Red loam (79.8 L. ha & 61.7%)	Parts of Kancheepuram, Cuddalore, Salem, Dharmapuri, Coimbatore, Tiruchirappalli, Thanjavur, Ramanathapuram, Madurai, Tirunelveli, Sivagangai, Thoothukudi, Virudhunagar, Dindigul and The Nilgiris Districts.
Laterite soil (3.8 L.ha & 2.9%)	Parts of The Nilgiris District
Black soil (15.0 L. ha & 11.6%)	Parts of Kancheepuram, Cuddalore, Vellore, Thiruvannamalai, Salem, Dharmapuri, Madurai, Ramanathapuram, Tirunelveli, Sivagangai, Thoothukudi, The Nilgiris, Virudhunagar and Dindigul Districts.
Sandy coastal alluvium (9.8 L. ha & 7.6%)	On the Coasts in the districts of Ramanathapuram, Thanjavur, Nagapattinam, Cuddalore, Kancheepuram and Kanyakumari
River alluvium (21.0 L. ha & 16.2%)	All river deltaic areas (Cauvery, Vaigai, Tambiraparani)

Source: Department of Economics and Statistics, Chennai