

Agricultural Production

Crop Production

- When plants of the same kind are grown and cultivated at one place on a large scale, it is called a **crop**
- Activities
 - Preparing the soil
 - Sowing
 - Adding manure and fertilisers
 - Irrigation
 - Plant Protection
 - Harvesting
 - Storage

Classification of Crops

Classification based on

- Climate
- Growing season
- Use/Agronomic classification
 - Cereals
 - Pulses
 - Oil Seeds
 - Vegetables
 - Forage
 - Fiber
 - Root
 - Tuber
 - Spices & condiments
 - Green manure crop
 - Medicinal & aromatic crops
- Duration of crops
 - Annual
 - Biennial
 - Perennial

Classification based on

- Cultural method/water
 - Rain fed
 - Irrigated crops
- Economic importance
 - Cash crop
 - Foodcrop
- Photosynthesis
 - C3 - Rice, soybeans, wheat, cotton, potato
 - C4 - Sorghum, Maize etc
 - CAM plants – Pineapple, sisal
- Length of photoperiod
 - Short-day plants
 - Rice, Jowar, green gram, black gram etc
 - Long-day plants
 - Wheat, Barley
 - Day neutral plants
 - Cotton, sunflower

Some Important Terms

- Crop calendar ●
- Crop rotation
 - Temporal land use pattern
- Cropping pattern
 - Spatial land distribution amongst crops
 - Monocropping
 - Monoculture
 - Multiple Cropping
 - number of crops in a year
 - » double, triple or quadruple cropping
 - Intercropping
 - Row intercropping
 - Strip intercropping
 - Mixed intercropping
 - Relay intercropping

Some Important Terms

- Cropping Pattern and
 - Yearly sequence and spatial arrangement of crops or of crops and fallow in a particular land area
- Cropping System
 - Cropping pattern plus all components required for the production of a particular crop and the interrelationships between them and environment

Cropping Intensity

- Cropping intensity is the number of times a crop is planted per year in a given agricultural area.
- It is the ratio of effective crop area harvested to the physical area.

$$\text{Cropping Intensity} = \frac{\text{Gross Cropped Area}}{\text{Net Sown Area}} \times 100$$

A farmer owns 5 hectares of land,

Kharif - paddy 5 ha

Rabi - paddy 3 ha

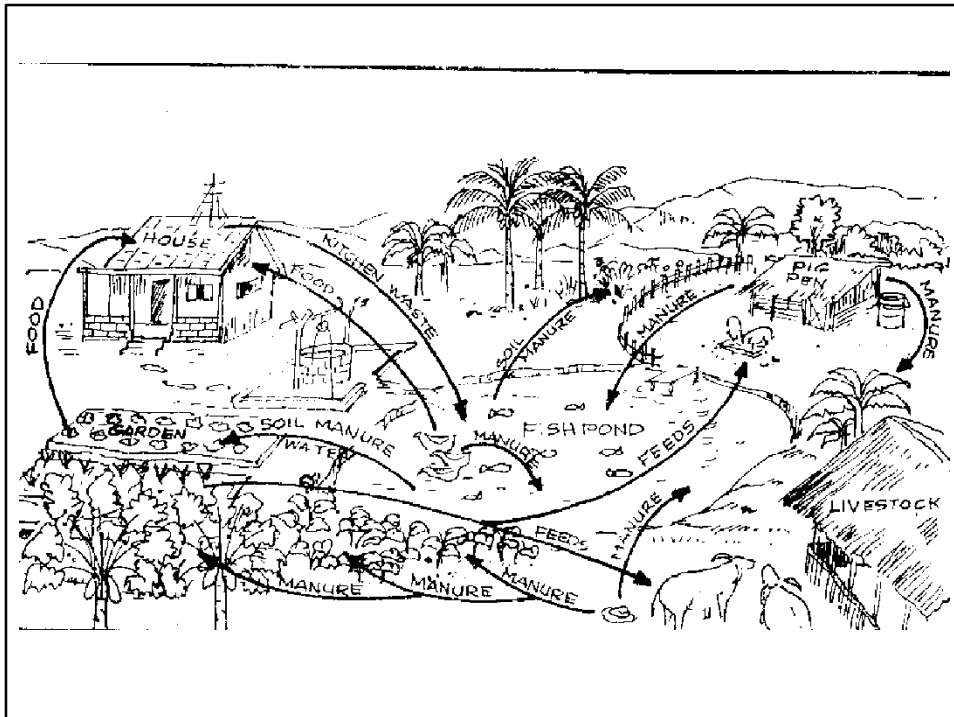
Example

Plot No.	Kharif Crop	Ha	Rabi crop	Ha	Zaid Crops	Ha
1	Paddy	2	Potato	2	Sesamum	2
2	G.nut	2	Wheat	2	Moong	2
3	Brinjal	2	Cabbage	2	Chilli	2
4	Okra	2	Cauliflower	2	Watermelon	2
5	Bitter Gourd	1	Pea	1	Cucumber	1
	Total	9		9		9

Plot No.	Kharif Crop	Days	Rabi crop	Days	Zaid Crops	Days	
1	Paddy	110	Potato	120	Sesamum	110	340
2	G.nut	90	Wheat	100	Moong	120	310
3	Brinjal	140	Cabbage	100	Chilli	200	440
4	Okra	100	Cauliflower	100	Watermelon	90	290
5	Bitter Gourd	100	Pea	90	Cucumber	100	290
	Total	9		9		9	

Some Important Terms

- Integrated farming System (IFS)
 - To compliment and maximize use of by products
 - To provide useful employment to all the family members
 - Maximizing land use
 - Value addition
 - Self sustainability
 - Less dependence on external resources



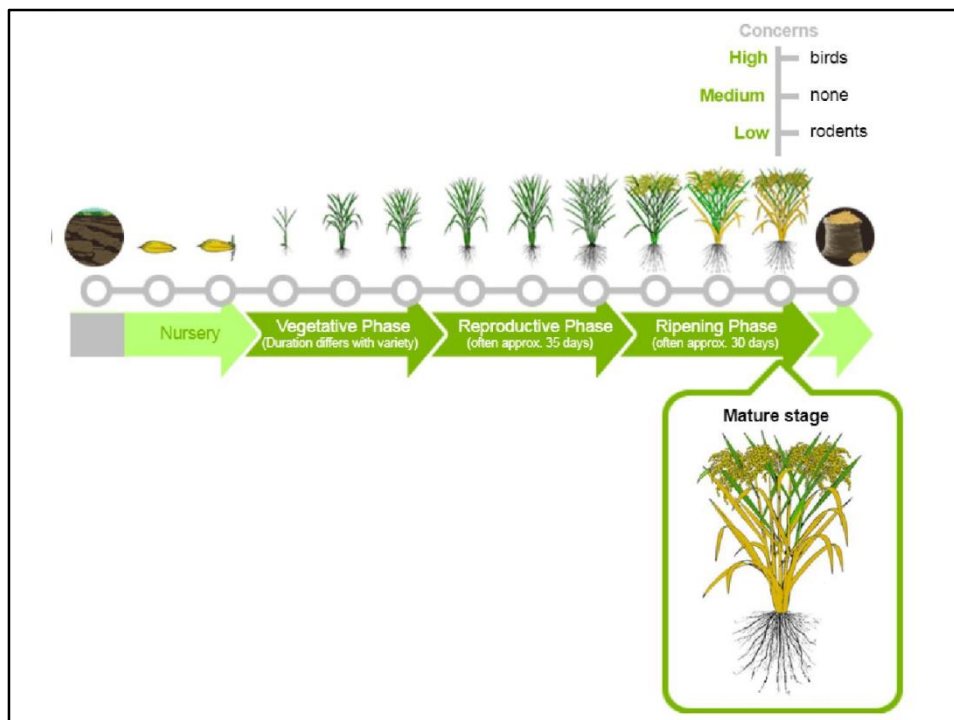
Stages of Crop

Cereal crops

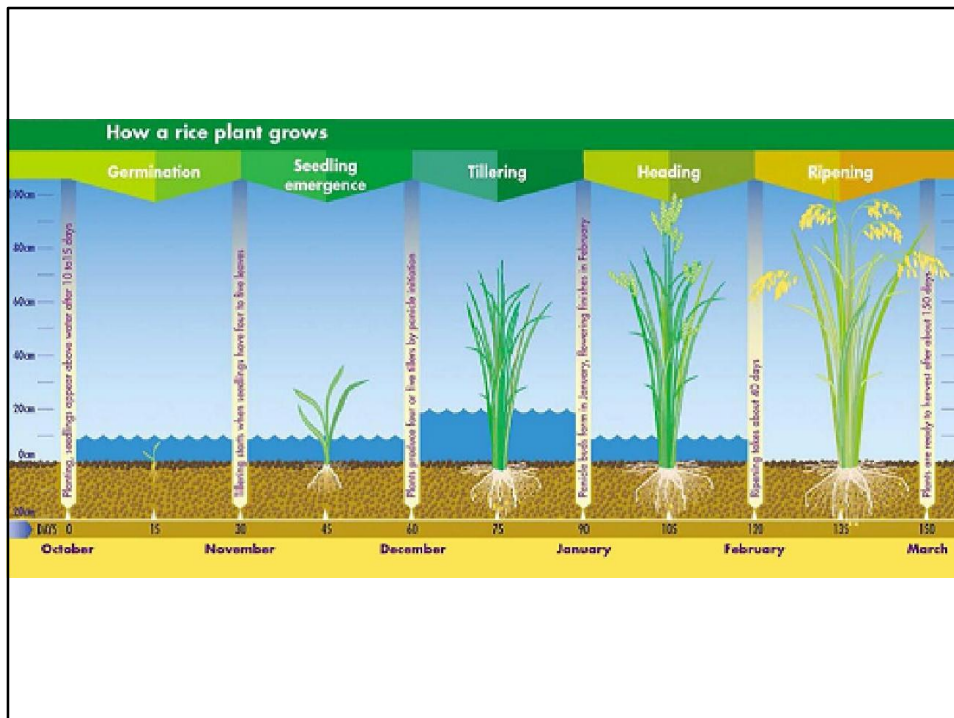
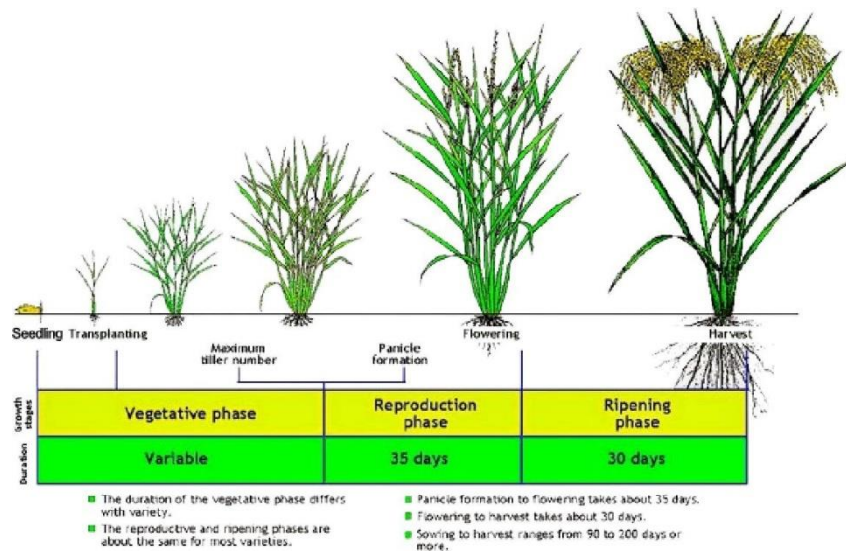
- Vegetative stage
- Stem elongation stage
- Booting stage
- Heading stage
- Anthesis stage
- Milking stage
- Dough stage
- Ripe seed stage

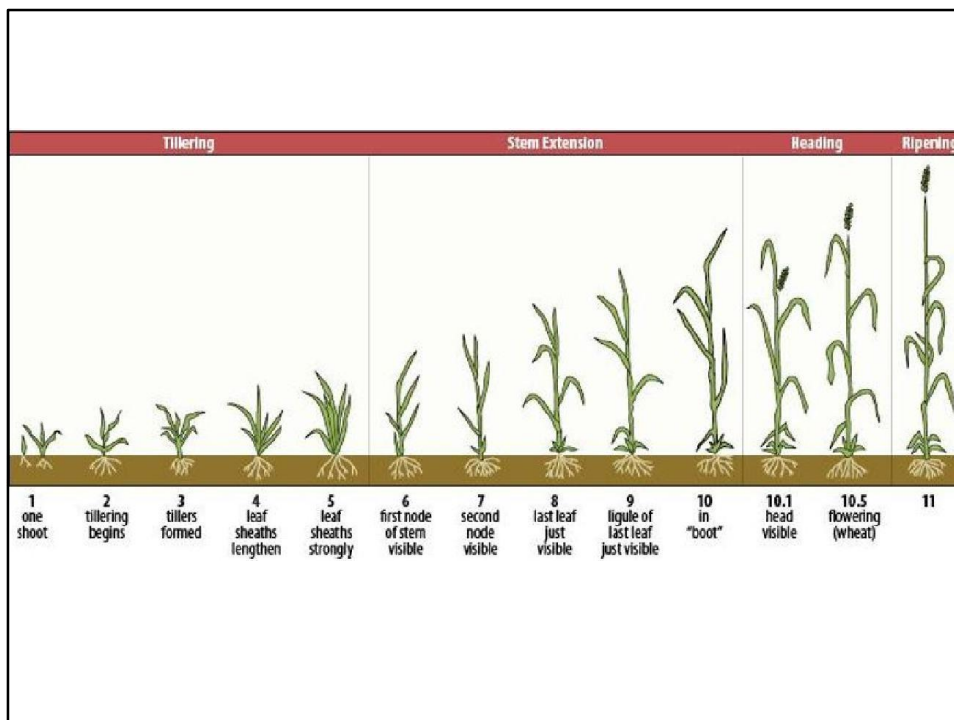
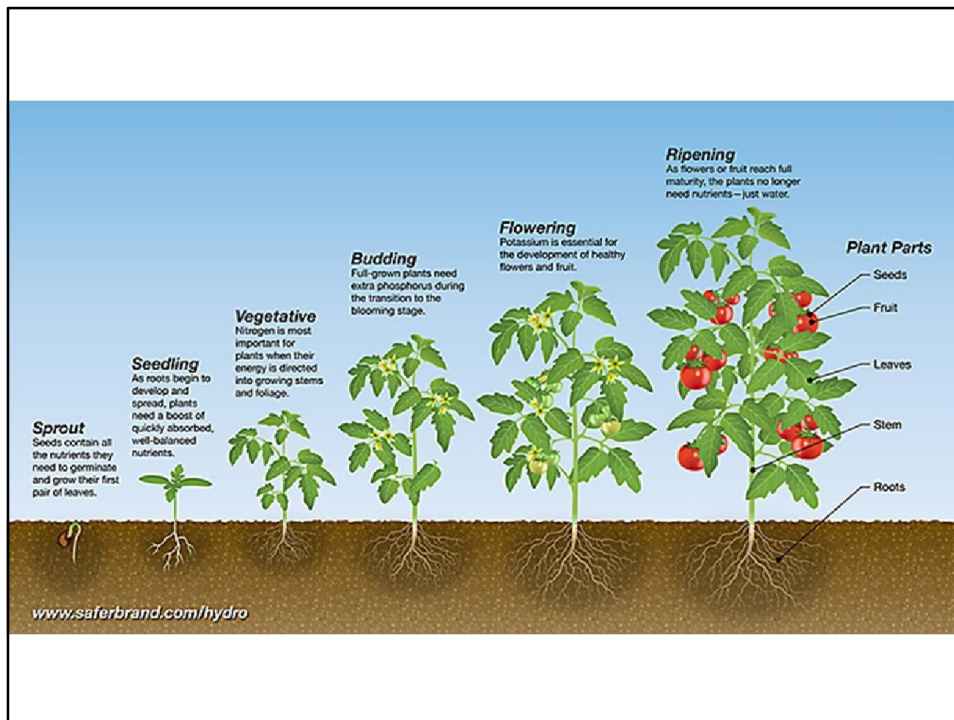
Legume crops

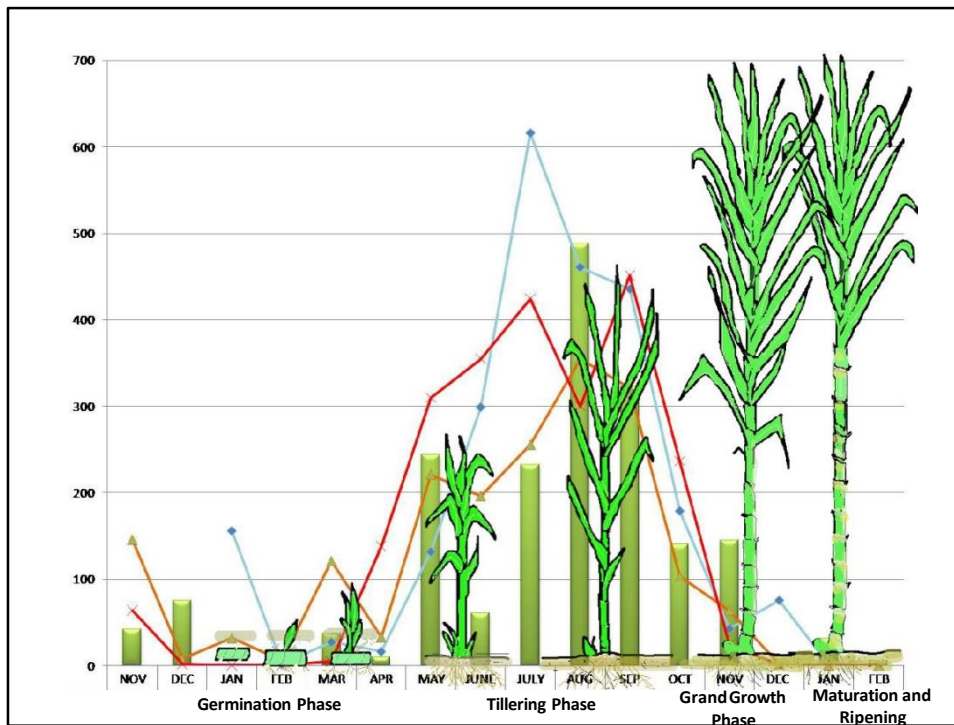
- Late vegetative
- Early bud
- Mid bud
- Late bud
- First bloom
- Mid bloom
- Full bloom



Example - Paddy







Critical Stages

Name of the Crop	Critical Stages	Name of the Crop	Critical Stages
Rice/Paddy	Tillering, Panicle initiation, Heading and Flowering	Ground nut	Flowering, Peg Formation and Pod Development
Wheat	Crown root initiation, Tillering to booting	Sesame	Blooming to Maturity
Sorghum	Booting, Blooming and Milky Dough Stage	Sunflower	Pre-flowering to Post-flowering
Maize	Silking and Tasseling to Dough stage	Soybean	Blooming and Seed Formation
Pearl millet	Heading and Flowering		
Finger millet	Primordial Initiation and Flowering	Onion	Bulb Formation and Pre-maturity
		Tomato	Flowering and Fruit Setting
Chickpea	Late vegetative phase	Chilies	Flowering and Fruit Setting
Black gram	Flowering and pod setting	Cabbage	Head Formation
Green gram	Flowering and pod setting	Potato	Tuber Initiation to Maturity
Beans	Flowering and pod setting	Carrot	Root Enlargement
Peas	Flowering and Early pod formation		
Cotton	Flowering and Boll Formation		
Citrus	Flowering, Fruit Setting and Fruit Enlargement		
Mango	Pre-flowering and Fruit Setting		

Principles of Crop Rotation

1. Area under Individual plots: The areas of individual plot for each crop should be approximately the same year after year. Unless price variation.
2. Number of Plots: The number of plots should be equal to the duration or multiple of it. When the total duration of rotation in cropping scheme is 4, then the number of plots may be 4 or minimum of it. i.e 8, 12, 16 and so on.
3. Selection of crops: Cropping Scheme is related to the profitable use of productive resources and management.
4. Profitable crops: the rotation should be planned around most profitable crops.
5. Meet the requirement: The cropping scheme should be so planned as to provide maintenance of soil fertility and other physical chemical properties.
6. The scheme should have one leguminous crop in year in its rotation for the maintenance of soil fertility and other physical chemical properties.

Factors Affecting Farming

Farmers make decisions about what to grow, what animals to keep, the level and type of inputs and the methods they will use. Their decisions are based upon

- Social & Economic
- Environmental
- Farmers' attitudes
- Level of knowledge.

Selection of Crops

Selection of crops depends on the situation of the farm to obtain maximum profit.

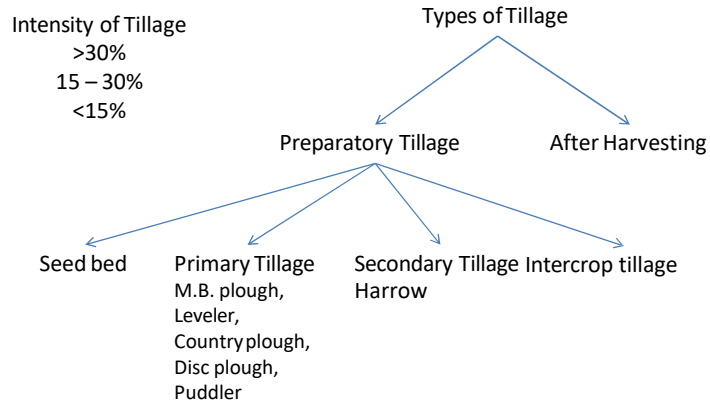
Farmer	Environment	Resources	Policies	Market
Attitude	Soil	Inputs	MSP	Storage
Knowledge	Climate	Technology	Schemes	Processing
Experience	Water			Marketing
Financial situation				Demand
Need				
Land Holding				

Farm Equipments and Tool

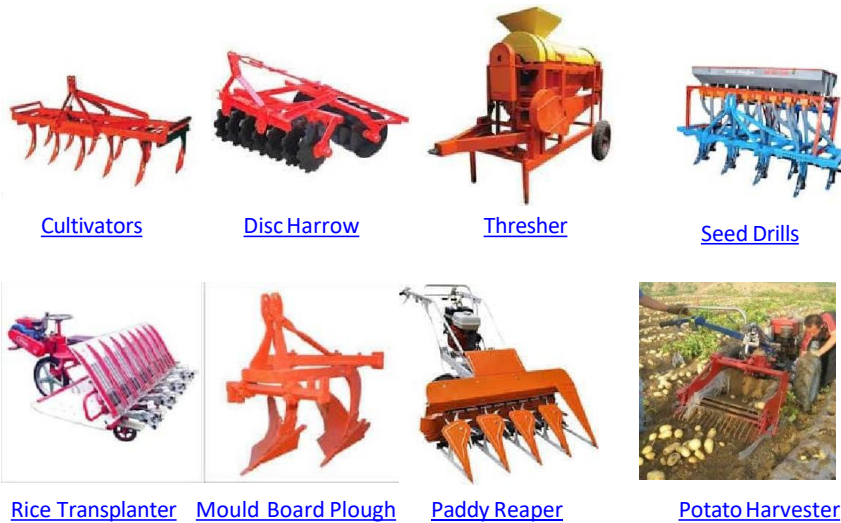
1. Tillage equipment
2. Seeding and planting equipment
3. Intercultural equipment
4. Irrigation equipment
5. Harvesting and threshing equipment

Tillage - Definition, Types, Function & Importance

Defined as mechanical modification of soil structure resulting in a soil tilth that is suitable for seed germination and plant growth.



Machines & Implements



Plant Nutrition

- 16 Essential elements
 - Macro – Primary - Non-mineral elements
 - C, H & O
 - N, P & K
 - Macro - Secondary
 - Ca, S & Mg
 - Micro – Trace
 - Iron
 - Boron
 - Chlorine
 - Manganese
 - Zinc
 - Copper
 - Molybdenum

I N M

Functions

- Nitrogen
 - Promotes growth of leaves and stems
 - Gives dark green color and improves quality of foliage
 - Necessary to develop cell proteins and chlorophyll
- Phosphorus
 - Stimulates early formation and growth of roots
 - Provides for fast and vigorous growth and speeds maturity
 - Stimulates flowering and seed development
 - Necessary for the enzyme action of many plant processes
- Potassium
 - Used to form carbohydrates and proteins
 - Formation and transfer of starches, sugars and oils
 - Increases disease resistance, vigor and hardiness

Functions

- Calcium
 - Improves plant vigor
 - Influences intake and synthesis of other plant nutrients
 - Important part of cell walls
- Magnesium
 - Influences the intake of other essential nutrients
 - Helps make fats
 - Assists in translocation of phosphorus and fats
- Sulfur
 - Promotes root growth and vigorous vegetative growth
 - Essential to protein formation
- Iron
 - Essential for chlorophyll production
 - Helps carry electrons to mix oxygen with other elements
- Copper
 - Functions
 - Helps in the use of Iron
 - Helps respiration
- Zin
 - c– Plant metabolism
 - Helps form growth hormones
 - Reproduction
- Boron
 - Affects water absorption by roots
 - Translocation of sugars
- Manganese
 - Plant metabolism
 - Nitrogen transformation

Summery

Aspect	Element	Function	Form
Vegetative	Nitrogen (N)	leafy growth	Nitrate NO ₃
	Carbon (C)	energy store	Carbonate
	Potassium (K)	leafy growth	
	Magnesium (Mg)	for chlorophyll	
Structure	Calcium (Ca)	cell walls	CaCO ₃
	Silicon (Si)	like cell "rebar"	w/ org. matter
Reproductive	Phosphorus (P)	seed, fruit, root	Phosphates
	Sulfur (S)	seed, fruit, root	Sulfate -SO ₄
	Manganese (Mn)	seed development	
	Nitrogen (N)	seed, fruit, root	Ammonia NH ₃

#	Nutrient	Macro/micro	Uptake form	Mobility in Plant	Mobility in Soil
1	Carbon	Macro	CO ₂ , H ₂ CO ₃		
2	Hydrogen	Macro	H ⁺ , OH ⁻ , H ₂ O		
3	Oxygen	Macro	O ₂		
4	Nitrogen	Macro	NO ₃ ⁻ , NH ₄ ⁺	Mobile	Mobile as NO ₃ ⁻ ; immobile as NH ₄ ⁺
5	Phosphorus	Macro	HPO ₄ ²⁻ , H ₂ PO ₄ ⁻	Somewhat mobile	Immobile
6	Potassium	Macro	K ⁺	Very mobile	Somewhat mobile
7	Calcium	Macro	Ca ²⁺	Immobile	Somewhat mobile
8	Magnesium	Macro	Mg ²⁺	Somewhat mobile	Immobile
9	Sulfur	Macro	SO ₄ ²⁻	Mobile	Mobile
10	Boron	Micro	H ₃ BO ₃ , BO ₃ ⁻	Immobile	Very mobile
11	Copper	Micro	Cu ²⁺	Immobile	Immobile
12	Iron	Micro	Fe ²⁺ , Fe ³⁺	Immobile	Immobile
13	Manganese	Micro	Mn ²⁺	Immobile	Mobile
14	Zinc	Micro	Zn ²⁺	Immobile	Immobile
15	Molybdenum	Micro	MoO ₄ ²⁻	Immobile	Somewhat mobile
16	Chlorine	Micro	Cl ⁻	Mobile	Mobile
17	Cobalt	Micro	Co ²⁺	Immobile	Somewhat mobile
18	Nickel	Micro	Ni ²⁺	Mobile	Somewhat mobile

I N M

- INM refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

Pests & Diseases - Paddy

- Tungro disease
- Blast
- Brown spot
- False Smut
- Sheath Blight
- Sheath rot
- Stem rot
- Rice hispa
- Case worm
- Leaf folder
- Plant Hoppers (GLH/BHP/WBPH)
- Stem borer
- Swarming caterpillar/army worm
- Stink Bug

IPM

Integrated Pest Management

- IPM based on
 - prevention, monitoring, and control
 - opportunity to eliminate or drastically reduce the use of pesticides, and
 - to minimize the toxicity of and exposure to any products which are used.
- IPM techniques
 - Cultural
 - Mechanical
 - Physical
 - Biological
 - Legistative and
 - Chemical.

Pests & Diseases - Wheat

- Leaf Rust (Brown Rust)
- Stem Rust (Black Rust)
- Stripe Rust (Yellow Rust)
- Common and Dwarf Bunt (Stinking Smut)
- Karnal Bunt (Partial Bunt)
- Loose Smut
- Flag Smut
- Powdery Mildew
- Alternaria Leaf Blight
- Fusarium Leaf Blotch (Snow Mold)
- Scab (Head Blight)
- Ergot
- Downy Mildew
- Common Root Rot, Foot Rot, and Crown Rot
- Sclerotium Wilt (Southern Blight)
- Black Molds (Sooty Molds)
- Bacterial Diseases
- Viral Diseases
- Aphids
- Stink Bugs
- Armyworms, Cutworms, and Stalk Borers
- Cereal Leaf Beetle
- Thrips
- Hessian Fly
- Wheat Stem Maggot
- Sawfly
- White Grubs
- Wireworms
- Slugs, Snails, Grasshoppers, and Crickets
- Mites
- Nematodes

Stored Grain Pests

- Sources of infestation
 - Fields
 - Carried-over commodities, waste and rejects.
 - Agricultural machineries
 - Processing plants Farm grain stores and re-used sacks
 - Means of transportation
 - Alternative hibernation sites and hosts



Cost of Cultivation- Methodology

- Three stage stratified random sampling
 - THESIL – First stage
 - VILLAGE – Second stage
 - HOLDING – Third stage

Cost of Cultivation

- **COST A1 includes:**

Value of hired human labour	}	Labour
Value of hired & owned bullock labour		
value of owned & hired machine labour		
Value of Seed (owned & purchased)	}	Inputs
Value of insecticides & pesticides		
Value of fertilizers		
Value of manure (owned & purchased)		
Irrigation charges	}	Taxes, Int. & Dep.
Land revenue & other taxes		
Interest on working capital		
Depreciation on implements & farm buildings		

A1

Cost of Cultivation

Head	Description
COST A2	COST A1 + Rent paid for leased-in-land
COST B1	COST A1 + Interest on owned capital assets (excluding land)
COST B2	COST B1 + Rental value of owned land + Rent paid for Leased-in land

Cost of Cultivation

Head	Description
COST C1	COST B1 + Imputed value of family labour
COST C2	COST B2 + Imputed value of family labour
COST C3	COST C2 + 10 % of cost C2

Cost of Production

Cost of Cultivation

vs

Cost of Production

Trends in Cost of Cultivation

- Structure
- Human labour
- Variations

Trends in Cost of Cultivation

- Structure of cost of cultivation has changed for all crops in all the states over time
- In case of paddy and wheat:
 - share of purchased inputs particularly fertilizer and irrigation has increased significantly
 - share of labour has decreased particularly in advanced states.

Trends in Cost of Cultivation

- In case of Sugarcane, Jute and Cotton:
- Human labour continues to be the most important item of cost about
 - 30 % in S. Cane and Cotton
 - > 50 % in Jute

Trends in Cost of Cultivation

- The cost of cultivation (Rs/ha) also varies significantly across states for all crops.

For Paddy:




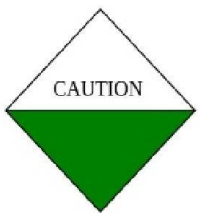
A.P – 22797, PUNJAB – 19126, ORISSA – 11646

For Wheat:

PUNJAB – 19479, U.P. – 13343, M.P. – 10260

For S.Cane:

A.P. – 45758, HARYANA – 24824, MAHARASHTRA – 40274, U.P. - 26148

Based on toxicity			
Extremely toxic	Highly toxic	Moderately toxic	Less toxic
Colour:- Red	Colour:-Yellow	Colour:- Blue	Colour:- Green
Toxicity:- Skull & Pison	Toxicity:- Pison	Toxicity:- Danger	Toxicity:- Caution
Oral LD50 :- 1-50	Oral LD50 - 51-500	Oral LD50 - 501-5000	Oral LD50 - >5000
DermalLD50 :- 1-200	DermalLD50 - 201-2000	DermalLD50 - 2001-20,000	DermalLD50 - >20,000
			

Crop Calendar and Major Producing states of India														
Season	S Sowing time					H Harvesting time					Growth period	Major Producing States		
	Kharif					Rabi							Zaid	
Crops ↓	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May		
Soybean	S	S		H	H									MP, MH, Raj
Cotton (Kapas)	S	S	S		H	H								Guj, MH, AP, MP, Kar
Turmeric	S	S	S				H	H	H	H				AP, TN, Or, WB, Kar, MH
Castorseed		S	S				H	H	H	H				Guj, AP, Raj
Guarseed [Cluster bean]		S	S		H	H								Rajasthan, Haryana, Punj.
Chilli (Kharif)			S				H	H						AP, Kar, Or, MH, WB, Raj
Chilli (summer)				H							S			AP, Kar, Or, MH, WB, Raj
Maize(Kharif) [Corn]	S	S	S	H										Kar, AP, MH, MP, UP
Potato (Kharif)	S	S		H	H									Karnataka, AP, TN
Potato (Rabi)				S	S	S		H	H	H				UP, WB, Punjab, Bihar, Orissa
Wheat					S	S	S		H	H	H			UP, MP, Punjab, Haryana
Maize (Rabi)[Corn]					S	S		H	H	H	H			Bihar, AP, TN, Kar
Rmseed					S	S			H	H				Raj, UP, Punj. Har, MP, WB, Guj
Chana[Gram/chickpea]					S	S			H	H				MP, UP, Raj
Barley					S	S			H	H				Rajasthan
Jeera [Cumin]					S	S			H	H				Gujarat, Rajasthan
Dhaniya [Coriander]					S	S	S		H	H	H			Rajasthan, MP, AP
Black Pepper				S	S		H	H	H	H				Kerala, Karnataka
Mentha	H	H							S	S		H		UP
Cardamom (Perennial Herb)				H	H	H	H	H						Kerala, Karnataka, TN
Potato (North Hills)		H	H	H	H				S	S	S			HP, Uttrakhand
Sugarcane (summer)						H	H	H	H	H	S	S		North India
Sugarcane (spring)						H	H	H	H	H	S	S		North India
Sugarcane (winter)				S	S	H	H	H	H	H				North India
Sugarcane (South India)		S			H	H	H	S	S	S				South India, Maharashtra