BASIC DATA FOR FIELD AND CROP MANAGEMENT

Area conversion

Area of 1 hectare (ha): 10000 m^2

Area of 1 acre (ac) = 4000 m^2

1 ha = 2.5 acres

1 acre = 0.4 ha

Spacing of crops and plant population:

Spacing: 60cm x 30cm

60cm = row to row spacing

30cm = plant to plant spacing within the row

$$\text{Number of plants per ha} = \frac{10000}{0.6\text{m} \times 0.3\text{m}} = \frac{10000}{0.18\text{m}^2} = 55555 \text{ plants/ha}$$

Calculation of number of plants per plot

Plot size: 5m (L) x 4m (W) = 20 m^2

$$= \frac{\text{Plot size in m}^2}{\text{Spacing in m}^2} = \frac{20}{0.18} = 111$$

Calculation of seed rate required per ha:

Test weight = 100 seed weight (g)

Example: Sunflower test weight: 4 g/100 seeds

100 seeds = 100 plants

1 ha = 55555 plants

100 seeds = 4 g

$$55555 \text{ seeds} = \frac{4 \times 55555}{100} = 2222 \text{ g} = 2.2 \text{ kg/ha}$$ (Recommended seed rate is 5 kg/ha)

Actual Germination % = 80 % = 2.2 x 100/80 = 2.2 x 1.25 = 2.75 kg (Minimum germination standard = 70%)
Number of seeds per hill = 2 = 2.75 x 2 = 5.5 kg ~ 5 kg/ha = 2 kg/acre

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Calculation of seed requirement per plot:

Seed rate = 5 kg/ha = 5 kg per 10,000 m^2 = 5,000 g per 10,000 m^2

Plot size: 200 m^2

10000 m^2 = 5 kg = 5000 g

$$200\ m^2 = \frac{5{,}000 \times 200}{10{,}000} = \frac{100{,}0000}{10{,}000} = 100\ g \text{ per plot}$$

FIELD LAYOUT OF EXPERIMENTAL PLOTS

Plot size and shape

Shape: Generally rectangle

All land preparation operations and crop management is done **ACROSS THE SLOPE**

Ensure within plot leveling for uniform irrigation and crop growth

Provide all round channels for each plot so that independent operations of irrigation, fertilizer application and spraying, etc, is possible without mixing or movement from one plot (treatment) to other.

On a perfect levelled plot, sowing to be done in North – South direction to get good sunlight distribution throughout the day. Otherwise, always follow across the slope direction.

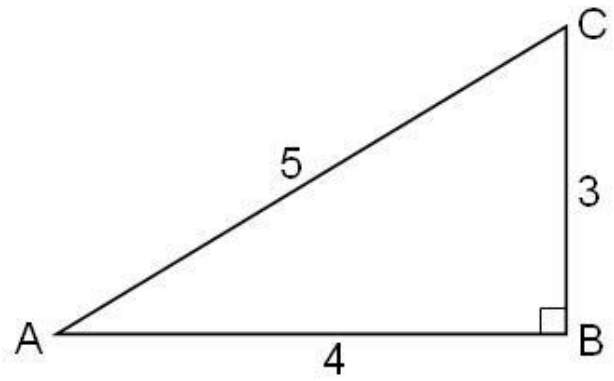
Obtaining 90° angle at corners of experimental layout use Pythagora's theorem (3-4-5 principle).

3-4-5 principle of obtaining 90° sides

1. From a corner point (B) of the well prepared plot, mark one straight base line (three point straight line method) along the major length of plot parallel to a road or path or bund.

2. Along this line measure 4 units (feet or meters) from point B and fix a peg. This is point A.

3. Mark a side line from point B in roughly 90° direction as BC



4. From point A, measure 5 units (feet or meters) towards the line BC and mark the intersection (cutting) of line BC and mark the intersection point as C.

5. Thus, the lines BA and BC are at 90° angle at point B. Extend the lines as per the desired length of plot with three point straight line method in both directions, taking the points BA or BC as two and the third as the extension point of the three point straight line.

6. Cross check the triangle BCA by a measuring the perimeter of the tringle equals to 12 units (feet or meters) i.e., 4+3+5 = 12

NUTRIENT MANAGEMENT

Essential nutrient elements for plant growth = 16

Sl No	Nutrient Element	Symbol	Status	Major Natural Source	Major Fertilizer Source
1	Carbon	C	Primary Nutrients	Air	Free
2	Oxygen	O		Water	Free
3	Hydrogen	H		Air	Free
4	Nitrogen	N	Major Nutrients	Organic matter and soil	Urea (46% N) DAP (18% N)
5	Phosphorus	P		Soil/ mineral	SSP (16% P_2O_5) DAP (46% P_2O_5)
6	Potassium	K		Soil/ Mineral	MOP (60% K_2O) SOP (50% K_2O)
7	Calcium	Ca	Secondary Nutrients	Soil/ mineral	Gypsum (Ca 21%; S 17.5%) Lime
8	Sulphur	S		Organic matter/ Soil/Mineral	Elemental S (90 to 99% S) Pyrites
9	Magnesium	Mg		Soil/ Mineral	Dolomite lime stone Magnesium sulphate
10	Zinc	Zn	Micro nutrients	Soil/ mineral	Zn Sulphate Zinc Oxide
11	Iron	Fe		Soil/ Mineral	Iron Sulphate
12	Copper	Cu		Soil/ mineral	Copper sulpahte
13	Boron	B		Soil/ Mineral	Borax (10% B) Solubor (20% B)
14	Manganese	Mm		Soil/ mineral	Manganese sulphate
15	Molybdinum	Mo		Soil/ Mineral	Ammonium molybdate Sodium molybdate
16	Chlorine	Cl		Water/ Salts	Free

FERTILIZER CALCULATIONS

Fertilizer and Manure:

Manures: Organic. Example: FYM, Compost, Green Manure, Crop Residue, etc.
Fertilizers: Manufactured or soil mines and processed. Mostly inorganic. Example: Urea, SSP, MOP, etc.

RDF = Recommended Dose of Fertilizer: N : P_2O_5 : K_2O kg/ha

Example: RDF for Sunflower: 60:60:30 kg N:P_2O_5:K_2O/ha

Major fertilizers:

N : Urea (46% N)
DAP (18% N + 46% P_2O_5**)**

P_2O_5 : SSP (16% P_2O_5)
DAP (46% P_2O_5 + 18% N**)**

K_2O : MOP (60% K_2O)

S: Elemental Sulphur (90 or 99% S)
Gypsum (Ca = 21%; S = 17.5%)

Conversion of recommended nutrient to required major fertilizer

N x 2.17 = Urea

P_2O_5 x 6.25 = SSP

K_2O x 1.67 = MOP

Calculation of NPK required per hectare based on RDF:

Example: RDF for Sunflower: 60:60:30 kg N:P_2O_5:K_2O/ha

60kg N/ha = 60 x 2.17 = 130.2 kg Urea/ha

60 kg P2O5/ha = 60 x 6.25 = 375 kg SSP/ha

30kg K2O/ha = 30 x 1.67 = 50.1 kg/ha

Calculation of fertilizer (grams) required per plot:

Example formula for N:

$$\frac{\text{Recommended (N kg/ha) x Plot area (m}^2\text{)}}{\text{10000 (m}^2\text{)}} \times 2.17 \times 1000 = \text{Required urea g/plot}$$

Similarly for P_2O_5 and K_2O, substitute the values as per the requirement and as per the plot size and use the specific conversion factors.

Pot culture studies:

Weight of 6" soil depth = 200,0000 = 2 million kg/ha (1 million = 10 lakhs) (1 million = 1 x 10^6)

AFC = Acre Furrow Slice = 6" depth = 2 million pounds/acre (~2.5 lb = 1 kg) (2.5 acres = 1 ha) i.e lb/ac = kg/ha

Fertilizer calculations for pot culture studies are based on soil weight, with the RDF value is for the 2 million kg soil weight per hectare (instead of 10,000m^2 of area).

PLANT BREEDING AND CROP IMPROVEMENT

Genetic Improvement of crops

- Variety & Hybrid
  - Parental lines
    - Inbred lines
    - Pure line
    - Advanced generation Breeding lines

Nature of works

- Labeling (check and ensure)
- Selfing (timely)
- Sibing (timely)
- Crossing (timely)

Example of traits (Unique characters)

- Early flowering
- Very short plant type
- Very long spike
- Resistance to disease and insects
- High oil content
- High ricinoleic acid content
- High oleic content
- High seed weight

DATA RECORDING, TABULATION AND MEANS CALCULATION

Accession/entry	Plant No.	Plant height (cm)	Number of nodes	100-seed weight (g)
Replication I		1	2	3
RG109	P1	50.5	11.8	26.9
	P2	63.2	13.8	27.7
	P3	54.6	11.4	25.3
	P4	56.1	12.3	26.6
	Average	Total/4		

SEED PRODUCTION

(Operational definitions/meanings)

Seed Vs Grain

Pollination and seed set

Self pollination

Cross pollination

Variety: The seed obtained from the harvest of a crop can be used for repeated cultivation of a crop.

Hybrid: The off spring from a cross between parents. For commercial cultivation each time new F1 seed to be planted.

Genetically Modified Plants or Transgenic crops: The alien trait to the species is inserted using biotechnological tools to develop a plant type that has enhanced trait quality.

Types of seed:

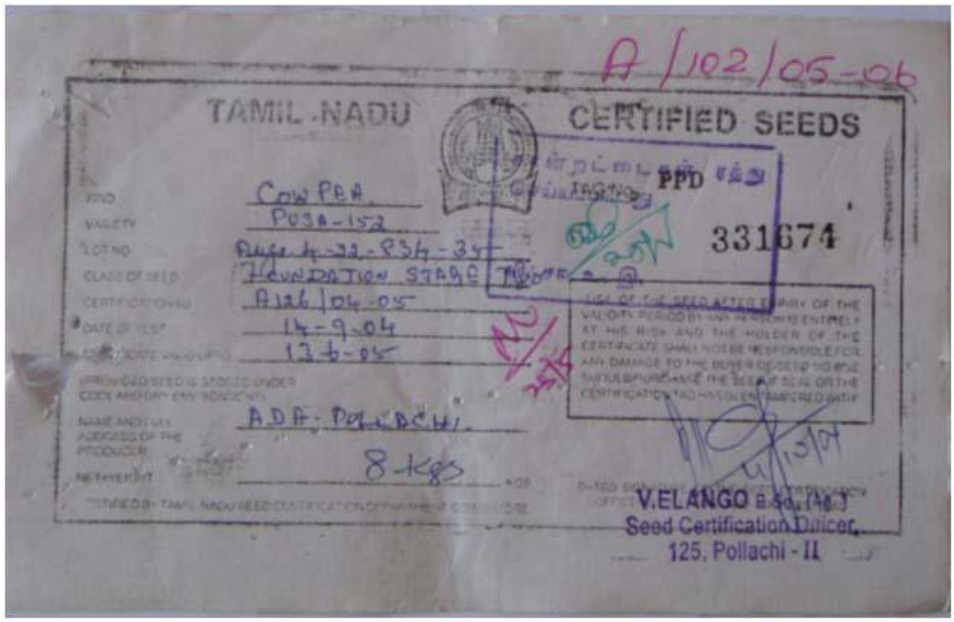
1. Nucleus seed
2. Breeder seed
3. Foundation seed
4. Certified seed
5. Truthfully labeled seed

Labels of seed certification and class of seed

Breeder seed

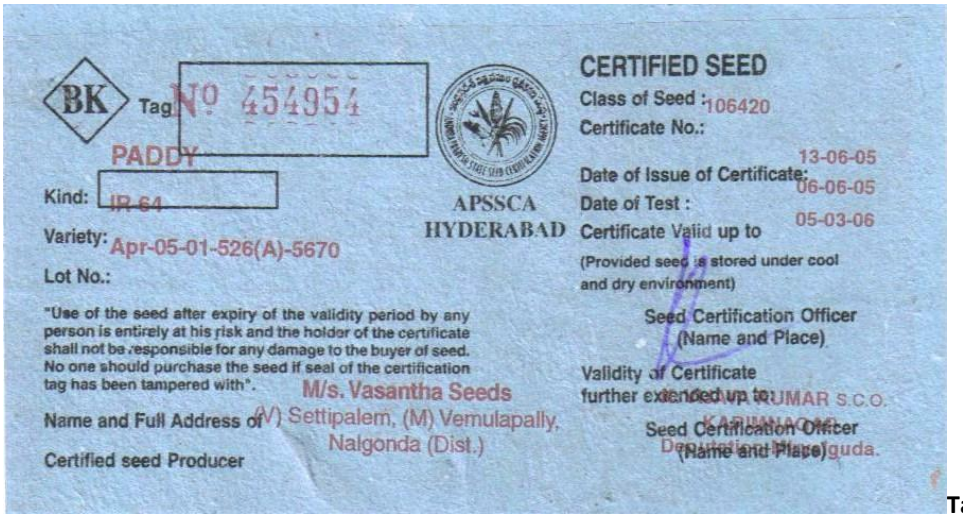
Tag colour: Yellow

Foundation seed



Tag Colour: White

Certified seed



Tag Colour: Azar blue

Rouging: Removing of undesirable and off-type plants before flowering and or harvest

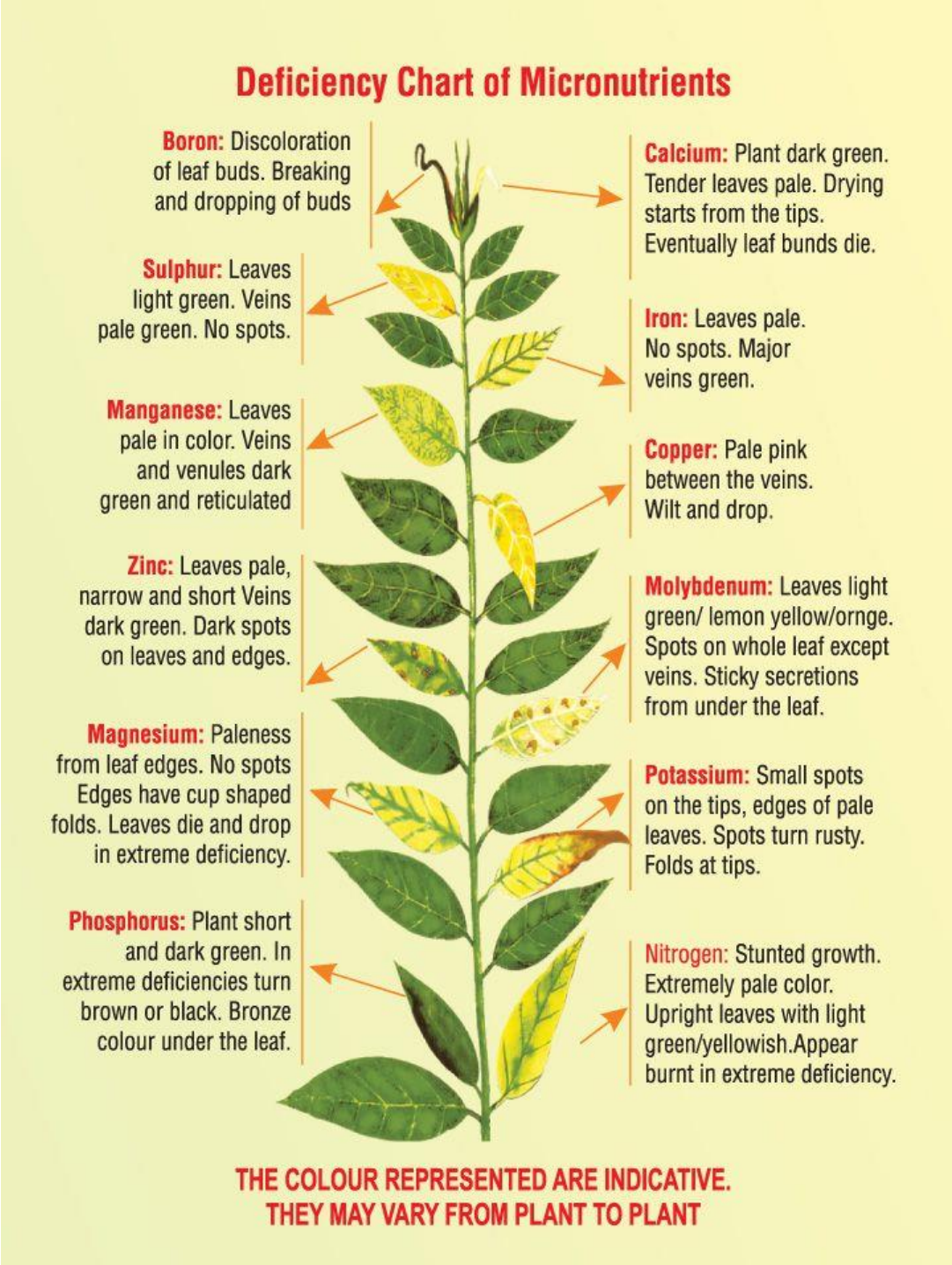
Viability: Live seed with capacity to grow

Dormancy: Failure of viable seed to germinate

NUTRIENT DEFICIENCY IN PLANTS

Mobile element: Dissolve easily and move freely as per the soil water and in the plant. Ex. Nitrogen

Immobile element: Sparingly soluble in water and have low mobility from the site of application in soil and accumulates in lower portions of plants. Ex. Calcium



General Symptoms of deficiency of elements: (Example on Sunflower and Castor)

Mobile elements (N): Lower and older leaves show chlorosis or yellowing. Poor growth of seedling/plant.

Immobile elements (Ca): Growing tips and young leaves show chlorosis and poor growth.

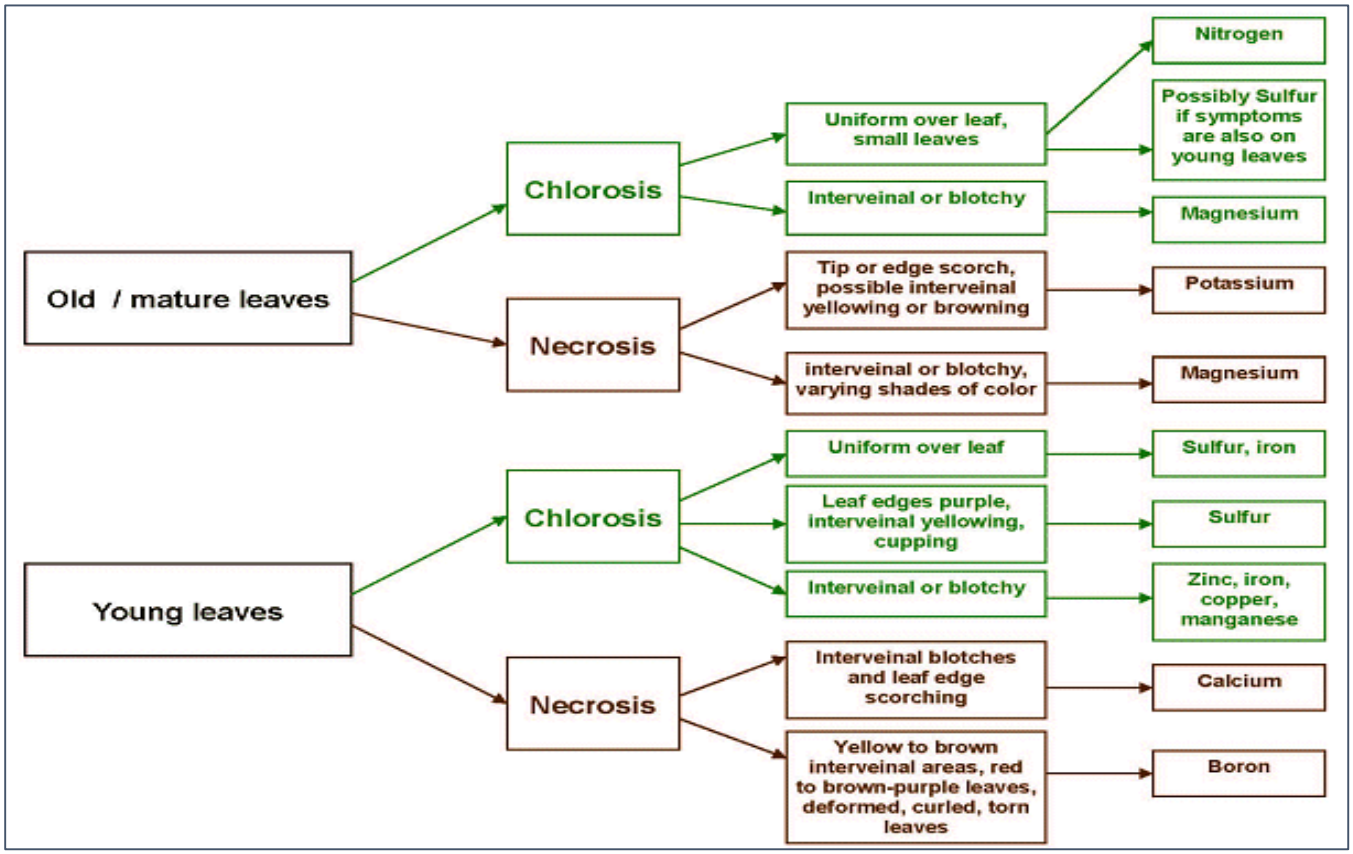
Micro-nutrients (Fe): General inter-veinal chlorosis (Only veins of leaves are green rest of lamina yellowish).

Phosphorus (P): leaf margins turn brown or violet colour and get necrotic

Potassium (K): Leaf tip and margins become necrotic.

Boron: Motling and crinkling of leaves, poor seed set.

Diagnostic Techniques for identifying nutrient deficiency

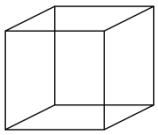


IRRIGATION WATER MANAGEMENT

Irrigation measure: Volume

Volume = Area (m^2) x depth (m) = mm^3 or cubic m

1 cubic meter = 1m length x 1 m width x 1 m depth = 1000000 ml = 1000 liters



1 cubic foot = 28.3168466 litre (= 1 feet length x 1 feet width x 1 feet depth)

Water storage in dams or reservoirs

TMC FT = Thousand million cubic feet = Tmc

= 28316.85 million litres

Flow of water:

Cusec = Cubic feet per second

So, 1 cusec of water = 28.32 litre water flowing per second.

Methods of irrigation

1. Flood
2. Check basin
3. Ridges and furrow (All furrows or Alternate furrow irrigation)
4. Broad bed and furrow

Micro-irrigation techniques:

1. Sprinkler
2. Rain gun
3. Drip
4. Sub-irrigation

Water Use Efficiency (WUE)

$$WUE = \frac{\text{Yield (kg)}}{\text{Water used or applied (mm)}} = \text{kg yield per mm of water}$$

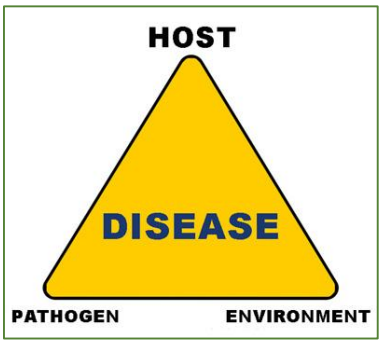
Main parts of drip irrigation system:

- Sand filter
- Algal/fungal filter
- Mains
- Sub-mains
- Laterals
- Emitters a) On-line emitter b) in-line emitter

PLANT PATHOLOGY

Pest: Insects, Diseases, Weeds

Pesticide: Insecticide, Fungicide and Herbicide



Causal agents	Biotic	Abiotic
Biotic	Fungal	Nutritional disorder
	Bacterial	Geentic disorder
	Viral	

Insecticide: Toxic to insect pests

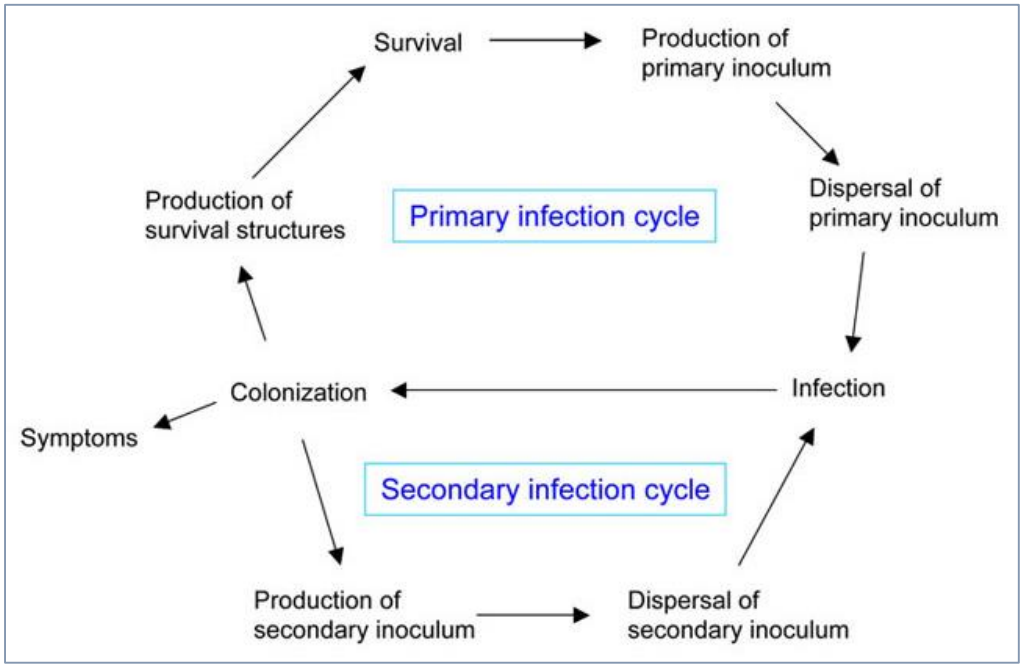
Fungicide: Toxic to pathogenic microbes

Herbicide: Toxic to plants

Contact pesticide: Kills the pest only on contact. Examples:

Systemic pesticide: Enters the plant system and kills the pest anywhere on the plant. Examples:

Disease cycle



Comparison of disease cycles

	Fungi	**Bacteria**	**Viruses**	**Nematodes**
Survival	Crop residue Soil Alt. hosts -	Crop residue Soil Alt. hosts Insect vectors	- - Alt. hosts Insect vectors	Crop residue Soil - -
Dispersal	Wind Rain Insects	Wind Rain Insects	- - Insects	Tillage Equipment Water run-off
Infection	Directly Wounds Insect feeding	- Wounds Insect feeding	- - Insect feeding	Directly - -

Important diseases of Sunflower and Castor

Sunflower		**Castor**	
Disease	**Pathogen**	**Disease**	**Pathogen**
Alternaria leaf blight	*Alternaria helianthi*	Seedling blight	*Phytophthora parasitica*
Downy mildew	*Plasmopara halstedii*	Alternaria blight	*Cercospora ricinella*
Rust	*Puccinia helianthi*	Cercospora leaf spot	*Alternaria ricini*
Sclerotium wilt/rot	*Sclerotium rolfsii*	Wilt	*Fusarium oxysporum* f. sp. *ricini*
Charcoal rot	*Macrophomina phaseolina*	Root rot/Die-back	*Macrophomina phasiolina*
Head rot	*Rhizopus arrhizus*	*Botrytis gray rot*	*Botrytis ricini*
Viral diseases	Mosaic (CMV), SND, YRMV	Bacterial leaf spot	*Xanthomonas campestris pv. ricini*

Chemicals used for managing Castor diseases

Chemical name	Common name	Concept of active ingredient in formulation	Target organism/ host	Physiological stage for application	Recommended dose & mode of application
Thiram	Thiraflo, Royalflo, Thiram	Contact	Seedling blight, Alternaria leaf spot, Cercospora leaf spot, Macrophomina root rot	Seed treatment	3g/kg seed for seed treatment
Captan	N-trichtoromethylthio~cyclohexene-1,2-dicarboximide	contact		Seed treatment	3g/kg seed for seed treatment
Copper oxy chloride	Blitox; Green copper.	contact	Seedling blight, alternaria leaf spot, Cercospora leaf spot, Bacterial leaf spot	Seedling stage, vegetative stage.	3 g/lt at seedling stage ; vegetative stage : 2-3 times at 10-15 days interval depending upon severity of disease.
Bavistin Goldstin	Carbendazim	Systemic	Fusarium wilt,root rot, Botrytis grey rot	Seed treatment for wilt, root rot; Prophylactic spraying at flowering, capsule formation stage for grey rot.	Slurry 2g/Kg or seed soaking 1g/l for 12 hrs; 1g/lt for spraying two times at 15 days interval

Chemicals used for managing Sunflower diseases

Chemical name	Common name	Concept of active ingredient in the formulation	Target organism/ host	Physiological stage for application	Recommended dose & mode of application
Fungicides					
Thiram	Thiraflo, Royalflo, Thiram	Contact	Alternaria leaf spot , Charcoal rot	Seed treatment	3g/kg seed
Captan	Captan, Maestro Captan	contact		Seed treatment	3g/kg seed
SAAF	Carbendazim + Mancozeb	Systemic and contact	Alternaria Leaf spot, Powdery mildew	Seed treatment for leaf spot and spraying for leaf spot, Powdery mildew	2g/kg seed for seed treatment; 0.2% for spraying three times at 15 days interval

Bavistin	Carbendazim	Systemic	Leaf spot, Sclerotium rot Sclerotinia wilt & root rot	Seed treatment ;spraying at budding stage; floweing	2g/kg seed for seed treatment; 0.1% for spraying 2-3 times at 15 days interval.
Sulphur	Wettable Sulphur, Sulfex, Thiovit	90%	Powdery mildew, Rust	Spraying at vegetative stage	0.2% two times at 15 days interval.
Metalaxyl	Ridomyl MZ; Apron 35 SD	Systemic	Downy mildew	Seed treatment and spraying at vegetative stage	6g/kg seed for seed treatment; 0.2% for spraying two times at 15days interval
Mancozeb	Mancozeb; Dithane, Manzeb, Nemispot, Manzane; Gold M-45; MancoPlus, Penncozeb, Manzate, Tuberseal, Protect	contact	Alternaria leaf spot; rust; head rot / Sunflower	Stem elongation, flowering stages.	0.3%; three-four times at 10 days interval
Iprodione	Rovral, Proturf	systemic	Alternaria leaf spot, rust /Sunflower	Vegetative, flowering stages.	0.05% two times at 15 days interval
Copper oxy chloride	Blitox; Green copper, Copper Spray, Fixed copper, Copper oxychloride	contact	Head rot *(Rhizopus arrhizus)* /Sunflower	50% flowering atge	0.4%; 2-3 times at 15 days interval
Propiconazole	Tilt,Dhan	Systemic	Alternaria leaf spot, Powdery mildew / Sunflower	Foliar spraying at Stem elongation , flowering stage	1ml/lt ; 2-3 times at 15 days interval
Hexaconazole	Hexon, Contaf,	systemic	Alternaria Leaf spot, Powdery mildew / Sunflower	Foliar spraying at Stem elongation , flowering stage	1ml/lt ; 2-3 times at 15 days interval
imidacloprid	Gaucho	Systemic	Necrosis/sunflower	Foilar spray at vegetative / flowering stage	

Important diseases of Safflower

Disease	Pathogen
Safflower wilt	*Fusarium oxysporum* f.sp. *carthami*

Soil Application

The soil treatment methods involving the use of chemicals **are (i) Soil drenching (ii) broadcasting (iii) furrow application (iv) fumigation and (v) chemigation**

(i) **Soil drenching:** Requisite quantity of fungicide suspension is applied per unit area so that the fungicide reaches to a depth of at least 10-15 cm. Eg. Emisan, PCNB, Carbendazim, Copper fungicides, etc.

(ii) **Broadcastin**g: It is followed in granular fungicides wherein- the pellets are broadcasted near the plant.

(iii) **Furrow application** It is done specifically in the control of some diseases where the direct application of the fungicides on the plant surface results in phytotawa It is specifically practiced in the control of powdery mildew of tobacco where the sulphur dust is applied in the furrows.

(iv) **Fumigation**: Volatile toxicants (fumigants) such as methyl bromide, chloropicrin, formaldehyde and vapam are the best chemical sterilants for soil to kill fungi and nematodes as they penetrate the soil efficiently. Fumigations are normally done in nursery areas and in glass houses. The fumigant is applied to the soil and covered by thin polythene sheets for 5-7 days and removed..

(v) **Chemigation:** In this method, the fungicides are directly mixed in the irrigation water. It is normally adopted using sprinkler or drip irrigation system.

Foliar Application

Spraying

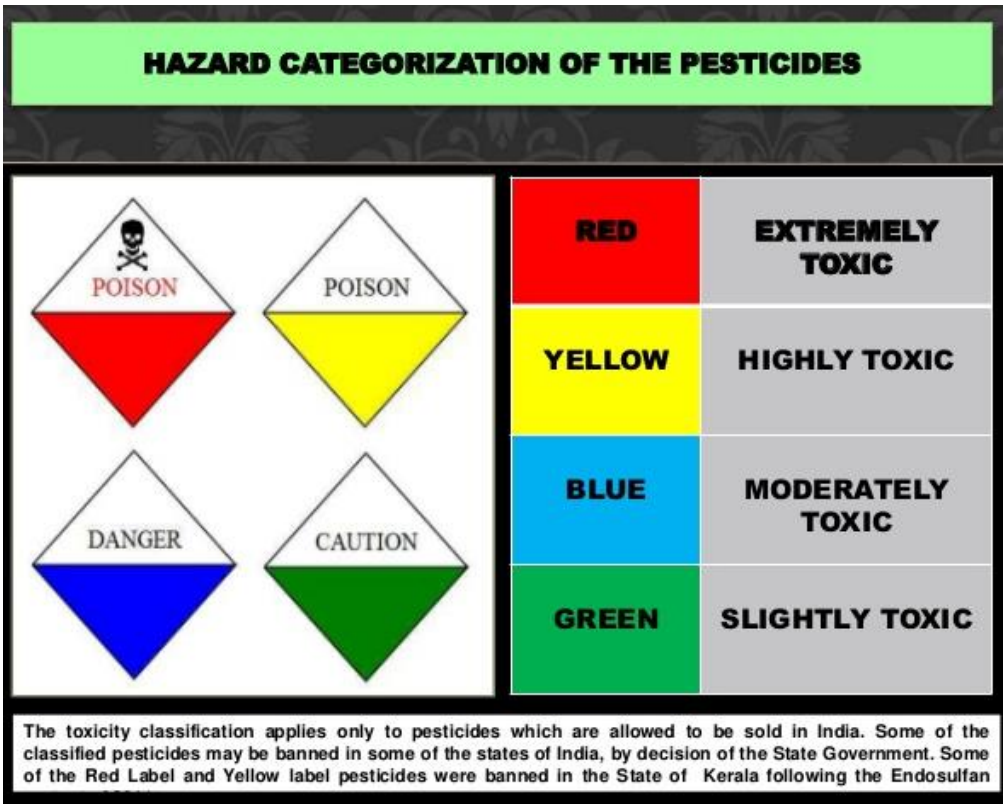
This is the most commonly followed method. Spraying of fungicides is done on leaves, stems arid fruits. Wettable powders are most commonly used for preparing spray solutions. The most common diluent or carrier is water. The dispersion of the spray is usually achieved by its passage under pressure through nozzle of the sprayer. The amount of spray solution required for a hectare will depend on the nature of crops to be treated. For trees and shrubs more amount of spray solution is required than in the case of ground crops. Depending on the volume of fluid used for coverage, the sprays are categorized into high volume, medium volume, low volume, very high volume and ultralow volume.

The different equipments used for spray application

- Foot-operated sprayer,
- Rocking sprayer,
- Knapsack sprayer,
- Motorized knapsack sprayer (Power sprayer),
- Tractor mounted sprayer,
- Mist blower and
- Aircraft or helicopter (aerial spray).

Classification of the Insecticides	Medium lethal dose by the oral route acute toxicity LD 50 mg/kg body weight of test animals	Medium lethal dose by the dermal route dermal toxicity LD 50 mg/kg Body weight of test animals	Colour of identification band on the label
1. Extremely toxic	1-50	1-200	Bright red
2. Highly toxic	51-500	201-2000	Bright yellow
3. Moderately toxic	501-5000	2001-20000	Bright blue
4. Slightly toxic	More than 5000	More than 20000	Bright green

Hazard colour codes on pesticide label



ENTOMOLOGY

PESTS

Defoliators : Semilooper, Spodoptera, Helicoverpa,

Sucking pests : Aphids, leaf hoppers, thrips, white flies

Beneficial insects

- Parasites
- Predators
- Pollinators

Insect Pests of Castor

Semilooper (*Achaea Janata*)

Tobacco caterpillar (*Spodoptera litura*)

Capsule borer (*Conogethes punctiferalis*)

Leafhopper, (*Empoasca flavescens*)

Registered insecticides, CIB, GOI, 2014 for CASTOR

Insecticides		**Insect Pests**	**Dosage**
Dimethoate 30% EC	Rogor	Jassids Mites Semilooper	1.7 ml/ l 1.7 ml/l 2.0 ml/l
Dichlorvos 76% EC	Nuvan	Hairy caterpillar	0.75 ml/l
Malathion 50% EC	Malathion	Jassids Semi looper	1.5 ml/l 2 ml/l
Trichlorfon 5% GR Trichlorfon 5% DUST Trichlorfon 50% EC		Capsule borer	2 kg ai/ha 2 ml/l
Bacillus thuringiensis var. *kurstaki*	Delfin	Hairy caterpillar, Semilooper	1 g/l

No fungicides registered for castor

Recommended pesticides - Castor

- Defoliators & Hairy caterpillars: Profenofos 50EC@1ml/l or Flubendiamide 39.35SC@ 0.2ml/l or Chlorantraniliprole 18.5 SC@ 0.3ml/l or Thiodicarb 75WP@ 1g/l
- Sucking pests (leafhopper, thrips): Thiamethoxam 25% WG @0.4g/l or Acetamiprid 20%SP @ 0.2g/l or Dimethoate 30EC @1.7ml/l
- Capsule borer: Profenofos 50EC@1ml/l or Spinosad 45SC@ 0.4 ml/l and Indoxacarb 14.5SC @ 1ml/l
- Grey rot: Carbendazim 0.1% / Thiophanate methyl 1g/l or Propiconazole 1ml/l at 50% flowering depending on weather forecast

- Wilt: Treat seeds with Carbendazim (2g/kg seed) or Thiram (3g/kg seed). Soaking seeds in Carbendazim (1g/l) for 12 hrs & shade drying before sowing

Insect Pests of Sunflower

Green Semilooper (*Thysanoplusia orichalcia*)

Tobacco caterpillar (*Spodoptera litura*)

Leafhopper (Jassid), (*Amrasca biguttula biguttula*)

Thrips, *Frankliniella scultze* (*Thrips palmi* and *Scirtothrips dorsalis*)

Capitulum borer / Head borer (*Helicoverpa armigera*)

Registered insecticides, CIB, GOI, 2014 for SUNFLOWER

Insecticides	Dosage	Insect Pests	Dosage
Dichlorvos 76% EC	Nuvan, Nukem- 776	Caterpillar, Cabbage looper, Semilooper	1ml/l
Imidacloprid 17.8% SL	Tatamida,	Jassid, Thrips, Whitefly	0.2ml/l
Malathion 50% EC	Malathion, Hilthion	Whitefly	1ml/l
Imidacloprid 48% FS	Confidor, Tatamida	Jassid, Whitefly (Seed Treatment)	5g/kg seed
Imidacloprid 70% WS		Jassid, Whitefly (Seed Treatment)	7g/kg seed

Recommended pesticides - Sunflower

- Defoliators: Profenofos (1 ml/l of water) or quinalphos (2ml/l) or chlorpyriphos (2.5 ml/l) or chlorantraniliprole (0.3 ml/l)
- Capitulum borer: Profenofos (1 ml/l) or spinosad (0.4 ml/l)
- Leafhopper and thrips: Seed treatment with imidacloprid 70 WS @ 5g/kg of seed; Spray imidacloprid 200 SL (0.2 ml/l) or dimethoate (1.6ml/l)
- Alternaria leaf blight: Treat seed with thiram or captan (2.5g) or carbendazim (1g/kg) or spray mancozeb @ 0.3% or rovral (iprodione) and tilt (propiconazole) 0.05%
- Powdery mildew: Wettable sulphur 0.2% or karathane 0.2% or propiconazole 0.1% or difenoconazole 0.05%

Insect Pests of Sunflower

Safflower aphid (*Uroleucon compositae*)

Safflower caterpillar (*Perigaea capensis*)

Army worm (*Spodoptera exigua*)

Tobacco caterpillar (*Spodoptera litura*)

Gram pod borer (*Helicoverpa armigera*)

Registered insecticides, CIB, GOI, 2014 for SAFFLOWER

Insecticides	Trade names	Insect Pests	Dosage
Dimethoate 30% EC	Rogor, Tara 909	Aphid	1.5 ml/l
Acephate 75% SP	Starthene, Lancer, Asataf	Aphid	1.0 g/l
Phenthoate 2% DP	Agrophen, Phentox	Aphid	20 kg/ha
Quinalphos 1.5% DP	Ekalux	Aphid	20 kg/ha

Recommended pesticides - Sunflower

- Safflower aphid: Dimethoate @ 1.6ml/l
- Safflower caterpillar: Indoxacarb 0.3ml/l or Quinalphos 2ml/l
- Gujhia weevil: Soil application of Phorate @ 1kg ai/ha at sowing followed by foliar sprays of chlorpyriphos @ 2ml/l
- Pod borer, Bihar hairy caterpillar, Safflower caterpillar, cut worms, *Spodoptera* : Quinalphos 2ml/l or Chlorpyriphos 2ml/l. Dusting Quinalphos 1.5D or Chlorpyriphos 1.5D @ 25 kg/ha (water scarce areas) – all the pests
- Wilt: Seed treatment with Carbendazim (slurry 2g/kg or seed soak 1g/l for 12 hrs)
- Alternaria leaf spot: Seed treatment with Thiram/Captan/Mancozeb @ 2- 3 g/kg. Spray Mancozeb 2.5g/l or Copper oxychloride 3g/l 2-3 times at 15 day interval starting from 90 days of crop growth

Dust Formulations: Dry areas, water scarce areas. Dry land crops

Quinolphos, Methyl parathion dust

Spray formulations: WP : Methomyl, Bavistin

EC, SC, FL : Liquids

Insecticide recommendation

Insecticides	Trade names	Pests	Dosage /L	Per 10 L
Dimethoate 30% EC	Rogor, Tara 909	Aphid	1.5 ml	15
Acephate 75% SP	Starthene, Lancer, Asataf	Aphid	1.0 g	10
Phenthoate 2% DP	Agrophen, Phentox	Aphid	20 kg/ha	
Quinalphos 1.5% DP	Ekalux	Aphid	20 kg/ha	
Thiamethoxam 25WDG	Actara	Aphid	0.2g	2
Acetamirpid 20SP	Pride	Aphid	0.2g	2
Clothianidin	Poncho	Aphid	0.2g	2

Last resort insecticides

	Dose /l	**Dose/10l**
Cypermethrin 10EC	1ml	10
Cypermethrin 25EC	0.4ml	4

INCOMPATIBILITY: Monocrotophos + Mancozeb X

Monocrotophos banned on vegetables

Endosulfan banned on all crops in India

PLANT PROTECTION EQUIPMENT

High volume sprayer: 300-500liters/ha: Example: Knapsack sprayers

Low volume sprayer: 50-150 liters/ha: Example: mist blowers

Ultra low volume sprayers: < 5 liters/ha: Electrodyne sprayers

Pressure:

Insecticide and fungicide: 40-60 PSI

Weedicide: 10-20 PSI

Horticulture (Tree) crops: 120PSI

When pressure decreases, droplet size increases

Nozzle type: Hollow cone: used only for insecticide and fungicide spray on to crops

Flat Fan : used only for herbicide spray on the soil

Spray volume requirement:

Total spray volume required: Weedicide: 200 liters/acre

Insecticide/fungicide at flowering stage of crops: 250 to 350liters/acre

Calibration:

$$F = \frac{S \times D \times A}{10000}$$

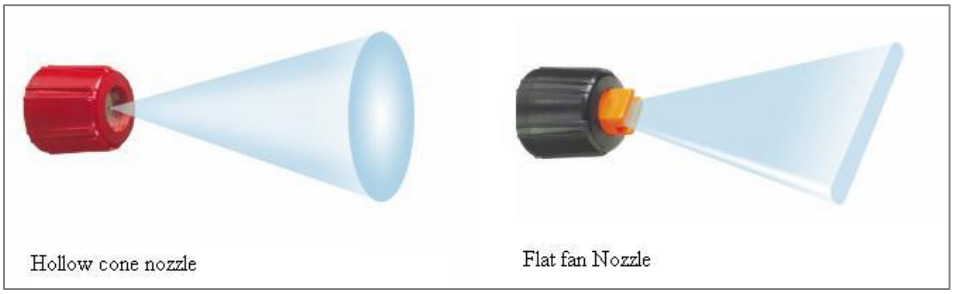
Where,

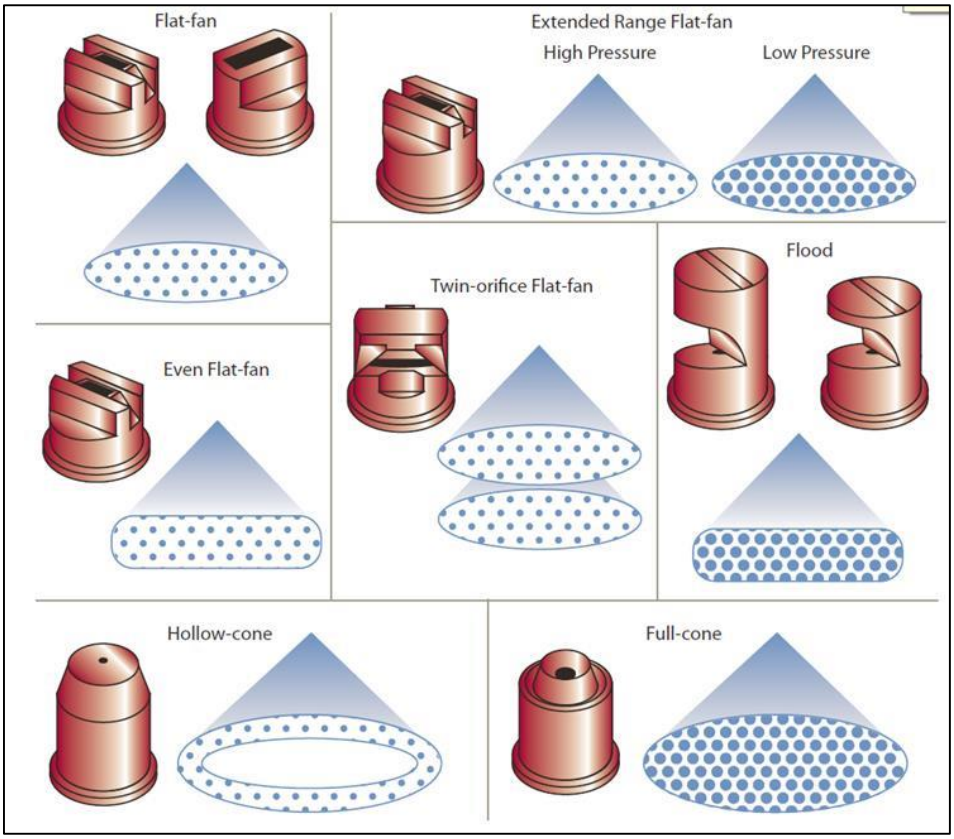
F = Flow rate in liters/min

S = Swath width in meters

D = Operator walking speed in meters/min

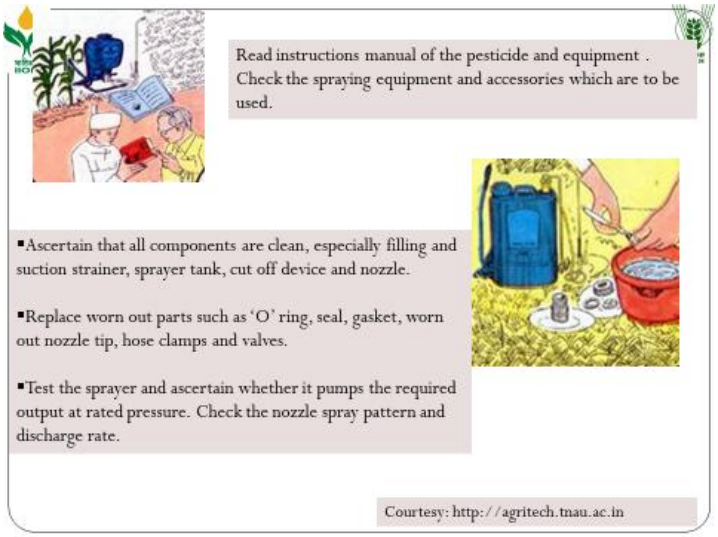
A = Application rate in liters/ha

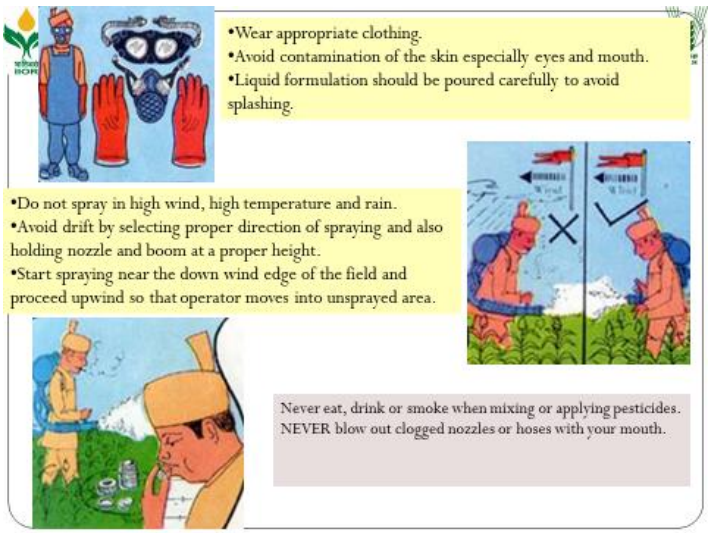


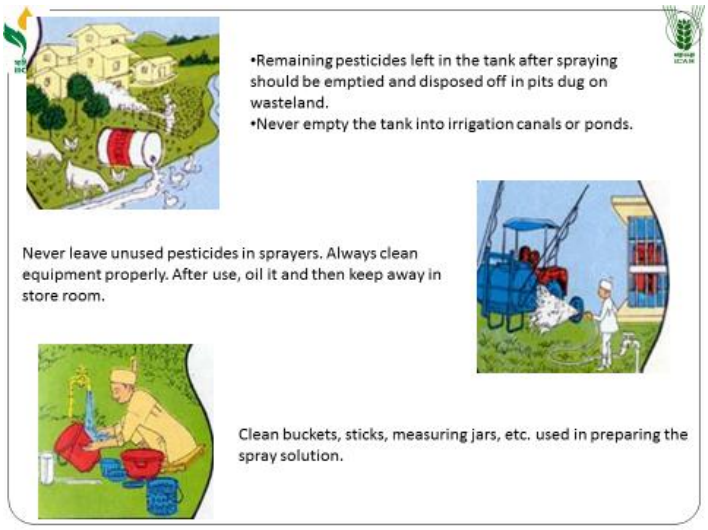


Precautions in using pesticides

- Don't tank mix ; mix in water and pour
- Do not fill up to mouth. In knap sack, fill only up to 3/4th
- Use correct nozzle
- Use correct dosage
- Do not spray against wind
- Do not touch insecticides with hands
- Do not smoke or eat while spraying
- Wash hands and body thoroughly
- Do not use same sprayer for herbicides and insecticides
- Wash sprayer and lance and nozzle thoroughly after spray







Practically all pesticides are toxic to man and animals. Therefore, great care should be taken in storing, using and disposing them. For safe handling of pesticides, **the following precautions may be taken**:

1. **Keep the insecticides in closed, properly labelled containers.**
2. **The containers containing pesticides should be stored in dry and cool place away from food and fodder**.
3. Use the pesticides strictly according to the instructions given on the container.
4. **Use only the recommended doses of the pesticides.**
5. **The nozzle and other parts of the sprayer should never be cleaned with the mouth.**
6. Persons handling pesticides should **avoid the contact of the pesticides with their skin and inhalation of vapours or mists. They should wear rubber gloves and the face should be covered with a suitable mask.**
7. The **operators should not smoke, eat or drink anything while applying pesticides**. **While spraying in open fields, the direction of the wind should be kept in mind.**

8. **After spraying pesticides, the operators should wash their hands and face with soap and should take bath and change their clothes. The clothes worn by them during operations should be washed properly.**
9. The **various containers such as buckets, ladler, etc. used for mixing pesticides should be washed properly after the operation.**
10. A **first-aid box should be kept ready** while pesticides are being applied.
11. In case **pesticides are inhaled or consumed accidentally, a doctor should be called at once after giving the first aid.** It is very important that the persons handling the pesticides should have a proper knowledge of the first aid to be given in case of any emergency.

ECONOMICS CALCULATION

1 man day = 8 hours of work for 1 person (male or female)

Returns = Income

Gross returns = Yield (q/ha) x Market rate (Rs/q)

Cost of cultivation = Total cost of growing crop (mostly variable costs on land preparation, seeds and sowing, manures and fertilizers, weeding, plant protection, harvesting, threshing, bagging, labour wages, etc.) (Rs/ha)

Net returns (Rs) = Gross returns (Rs) – Cost of cultivation (Rs)

$$\textbf{Benefit : Cost ratio (B:C ratio)} = \frac{\text{Gross returns (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

$$\textbf{Incremental Benefit : Cost ratio (IBC ratio)} = \frac{\text{Additional returns due to the particular treatment (Rs/ha)}}{\text{Additional cost of the particular practice (Rs/ha)}}$$

Additional returns = Additional yield (q) x Market rate (Rs/q)

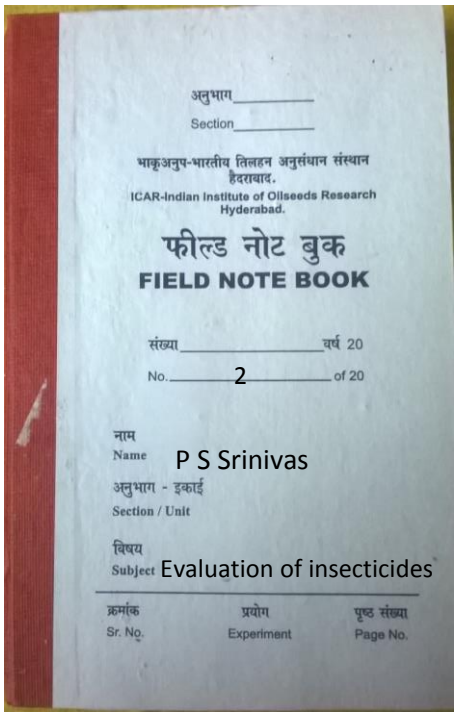
Additional cost = Cost exclusively on the treatment (Rs)

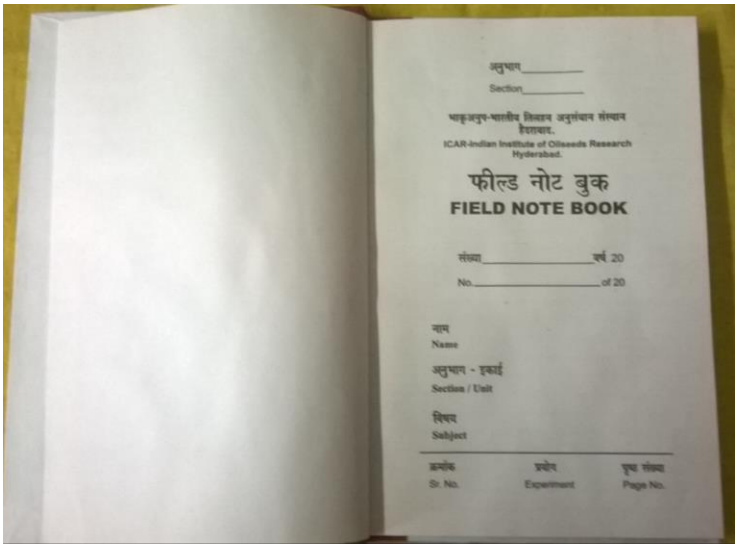
Costs:

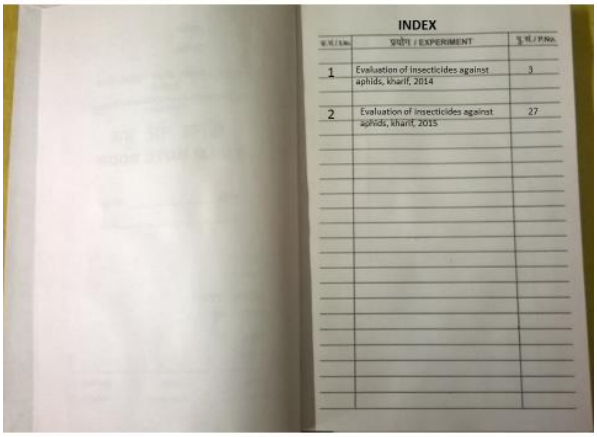
Fixed Cost: Depreciated value of land, tractor, machinery, permanent facility or infrastructure

Variable costs: Land preparation (tractor or bullock operation cost), seeds and sowing, manures and fertilizers, weeding, plant protection, irrigation, harvesting, threshing, labour wages, and any special operations for the crop.

DATA AND FIELD NOTE BOOK







- Learn the titles of the experiment
- Ask the scientist repeatedly till you understand completely.
- Go to the field always with field note book and layout plan
- Have keen observations on the treatment differences and plant growth differences – discuss with scientists
- Sincerity and timeliness/punctuality are utmost important in research

N ↑

LAY OUT		
R1	R2	R3
1	7	6
6	5	3
3	3	1
5	1	4
4	2	7
2	4	2
7	6	5

Title of the experiment:

Season and year: rabi, 2015

Farm and Block: Rajendranagar, B-1

Date of sowing: 15/10/15

Date of harvesting: 12/3/16

No of Treatments:8

No of replications: 3

Design : RBD

Plot size: 4 x 5 m

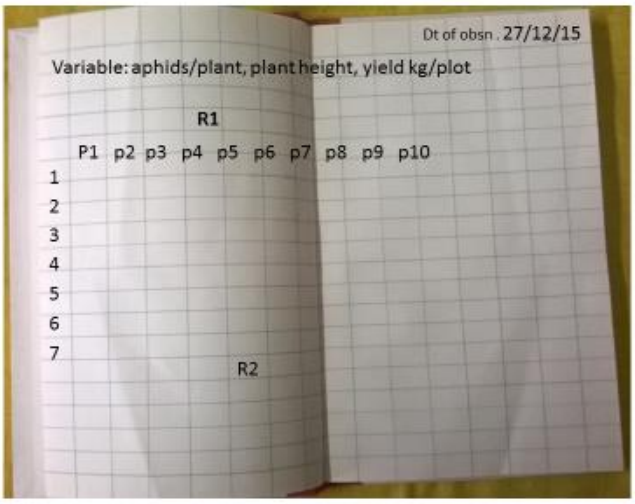
Dates of treatment: 15/11/15, 30/11/15

R1	R2	R3
1	7	6
6	5	3
3	3	1
5	1	4
4	2	7
2	4	2
7	6	5

Labelling

R1	R2	R3
R1T1	R2T7	R3T6
R1T6	R2T5	R3T3
R1T3	R2T3	R3T1
R1T5	R2T1	R3T4
R1T4	R2T2	R3T7
R1T2	R2T4	R3T2
R1T7	R2T6	R3T5

OBSERVATIONS

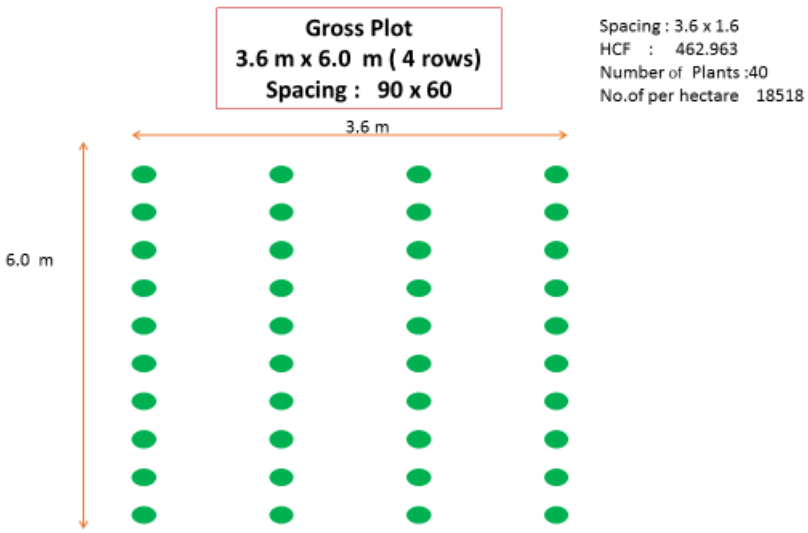


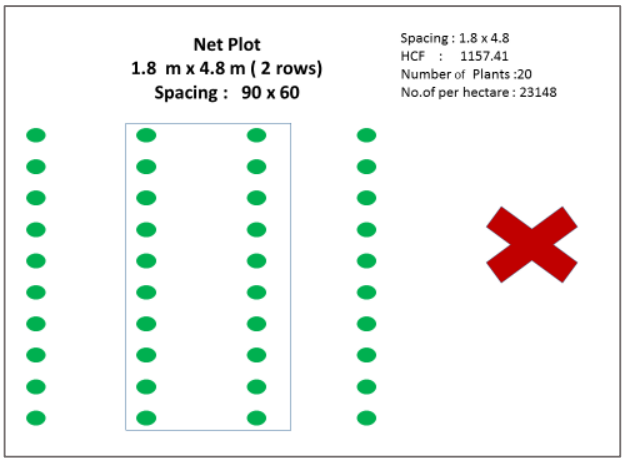
Rep1	T1	T2	T4	T5	T3
Rep3	T1	T3	T5	T2	T4

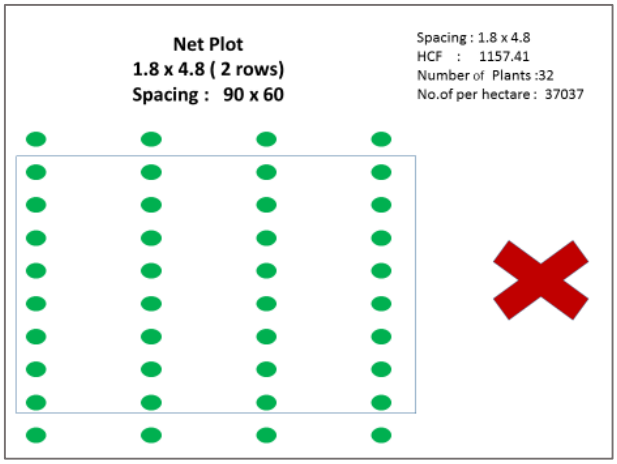
Rep1	T1	T2	T4	T5	T3
Rep3	T3	T2	T5	T2	T4

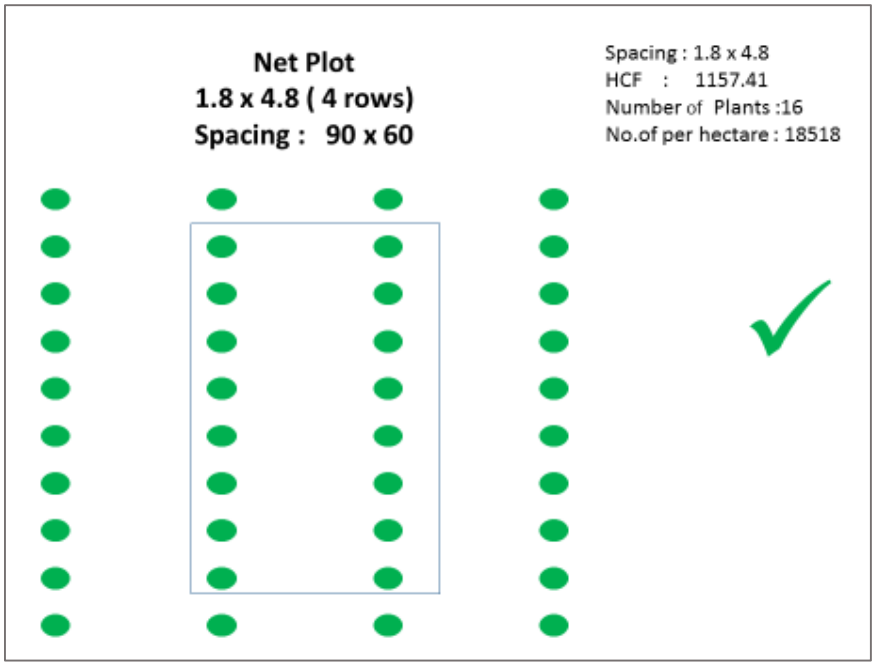
What is Gross plot and Net Plot ?

Spacing : 90 cm x 60 cm
Gross Plot : 3.6 m x 6.0 m (4 rows)
Net Plot : 1.8 m x 4.8 m (2 rows)









EXTENSION METHODOLOGY

Demonstration:

Method demonstration: Any individual practice demonstration ex: seed treatment, Boron spray, etc.

Result demonstration: Complete effect on crop from sowing to harvesting and yield. Ex: variety, fertilizer dose, etc.

Demonstration site selection:

Accessibility – road side

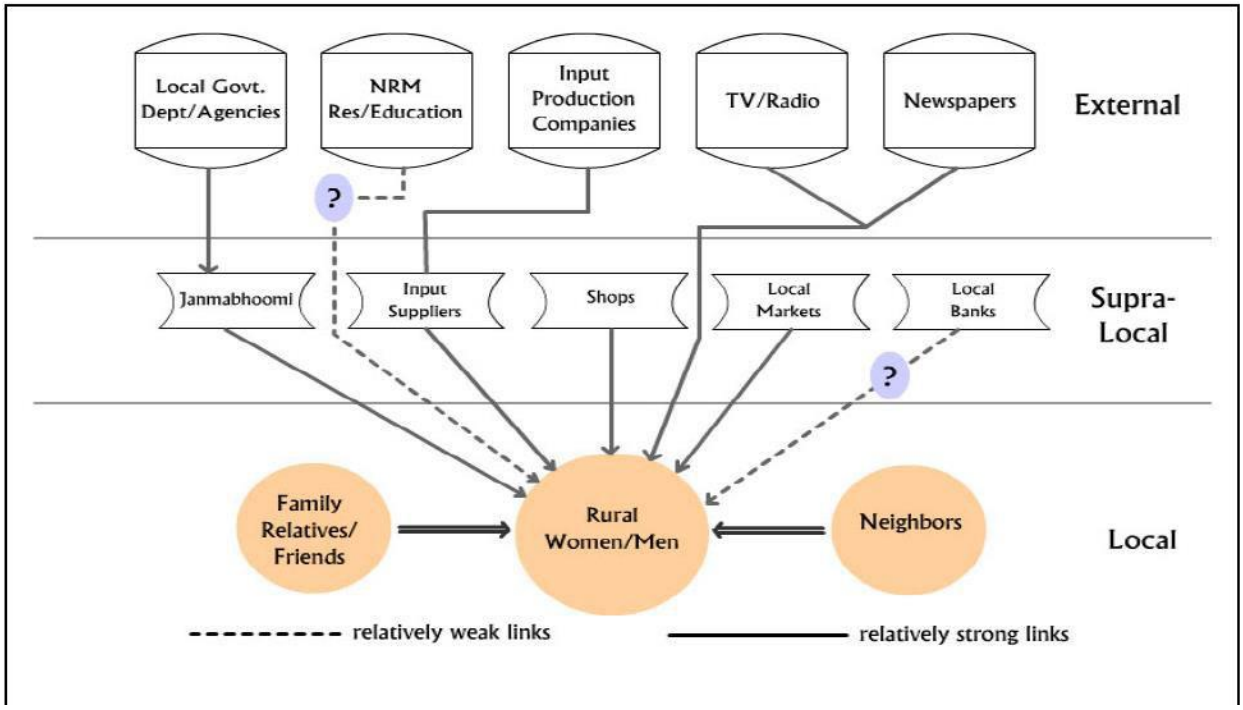
Farmer cooperation

ICT for transfer of technology : Information – Communication - Technology

Mobile based advisories – on real time and interactive

Remote monitoring the process

The information flow



FARM AND LABOUR MAANGEMENT

Farm Records

- Labour Indent register
- Muster Roll
- Crop Register
- Yield Register
- Farm Produce register
- Log books
- Usage register
- Indents – Labor and inputs

DOPT rules of Labour engagement: 240 days in a year for getting all benefits

Composting and crop residue recycling:

No crop residue to be burned.

All the residue should be composted

Compost Vs FYM: Compost is well decomposed whereas FYM is partially decomposed.

Vermicompost is prepared using earthworms.

Vermiwash is used both as nutrient source as well as protection and growth promotion of plants.

Green manure:

Green manuring in-situ: Green manure crops are grown in filed and incorporated. Example: Dhaincha and Pilli pesara green manuring

Green leaf manuring: Green leaf are brought from lopping of trees and incorporated in the field. Example: Pongamia green leaf manure

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LIBRARY AND INFORMATION SEARCH

Library

- Books
- Periodicals
- Journals

Catalogues

- Author index
- Subject index
- Year
- Publisher

ISBN Code

PHOTOGRAPHY TECHNIQUES

Importance of photography

Camera – Lenses: Normal, Tele lens, Wide angle Lens, Zoom lens

Angle of view and Angle of coverage: a) top angle b) low angle c) straight angle

Focusing

Use of background

OPERATIONAL HAZARDS AND SAFETY

Types of Hazards:

Natural: Abiotic and Biotic

Man made hazards: Fire accidents, electric shock, injuries caused by implements, road accidents

Health related hazards: Heart attack, hypoglycaemia

Farm operation related hazards.

Personal Protective Equipments (PPE)

- Aprons
- Sunglass
- Sun cream
- Eye goggles
- Steel toed shoes
- Gloves
- Helmet
- Field cap
- Mask

Laboratory safety and hazardous chemicals

Emergency Response: Alarm, follow instructions

Fire extinguisher location and usage

Personal and general laboratory safety

Read labels clearly and follow scrupulously

Get trained in use of chemicals

Wear PPE

Understand First aid and expertise

ADMINISTRATIVE RULES RELATED TO TECHNICAL STAFF

- Promotion policy for technical personnel
- Essential qualifications for promotion
- New circulars
- General administrative Rules

PURCHASE PROCEDURES AND BILLS

GFR Rules (General Financial Rules)

Government Receipts and Expenditure

BE = Budget Estimate (September)

RE = Revised Estimate

Cash Bill contents – Name, Letterhead, Date, Address, To, TAN, PIN, Certification

Vouchers

COMPUTER OPERATIONS AND INTERNET

Data entry: Microsoft Excel spread sheet

File creation, Naming and saving

Path and file location

Text entry and editing

Data entry through Excel spread sheet

Email and Internet

Searching for information using key words

DOR Web Site : www.iior-icar.org.in

Mail: http://mail.icar.gov.in

MIS-FMS: http://icarerp.iasri.res.in

Biometric attendance system: bas@dor.icar.org.in

MOTIVATION, TIMELINESS AND TEAM WORK

Self motivation techniques:

1. Following the inspiring person
2. Seeing the picture of the inspiring photo/person/situation/ quote
3. Listening to inspiring talk/saying/prayer/ content
4. Weighing benefit and loss of the work to be done
5. Breaking down the work into smaller tasks
6. Monitoring the growth or progress bar or chart or line and corrective action
7. Fixing deadline as challenge
8. Begin the work

Timeliness of work

- Attend to the work on priority of 'important and not urgent' work so that the work will not move to 'urgent and important' type of situation wherein stress builds.
- Avoid 'urgent and non-important' works
- Distance from acts of indulging 'not-urgent and not-important' activities.

For effective progress of team, Set clear goal, Communicate, Cooperate, and avoid selfishness as the progress of team is important over progress of individual in a team or institution growth.