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(An Autonomous Institution)

COIMBATORE-35.

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DEPARTMENT OF AGRICULURAL ENGINEERING

19AGE302ORGANIC FARMING

III YEAR- V SEMESTER

Inter cropping and crop rotation-Importance, benefits and products-Vegetable, Fruits, Flowering plants.

CONTENTS:

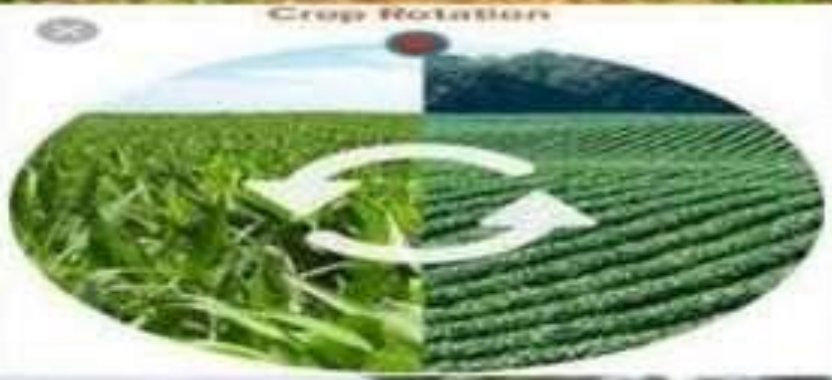
INTRODUCTION:

WHAT IS CROP?

- A cultivated plant that is grown in a large scale commercially, especially a cereal, fruit or vegetables.

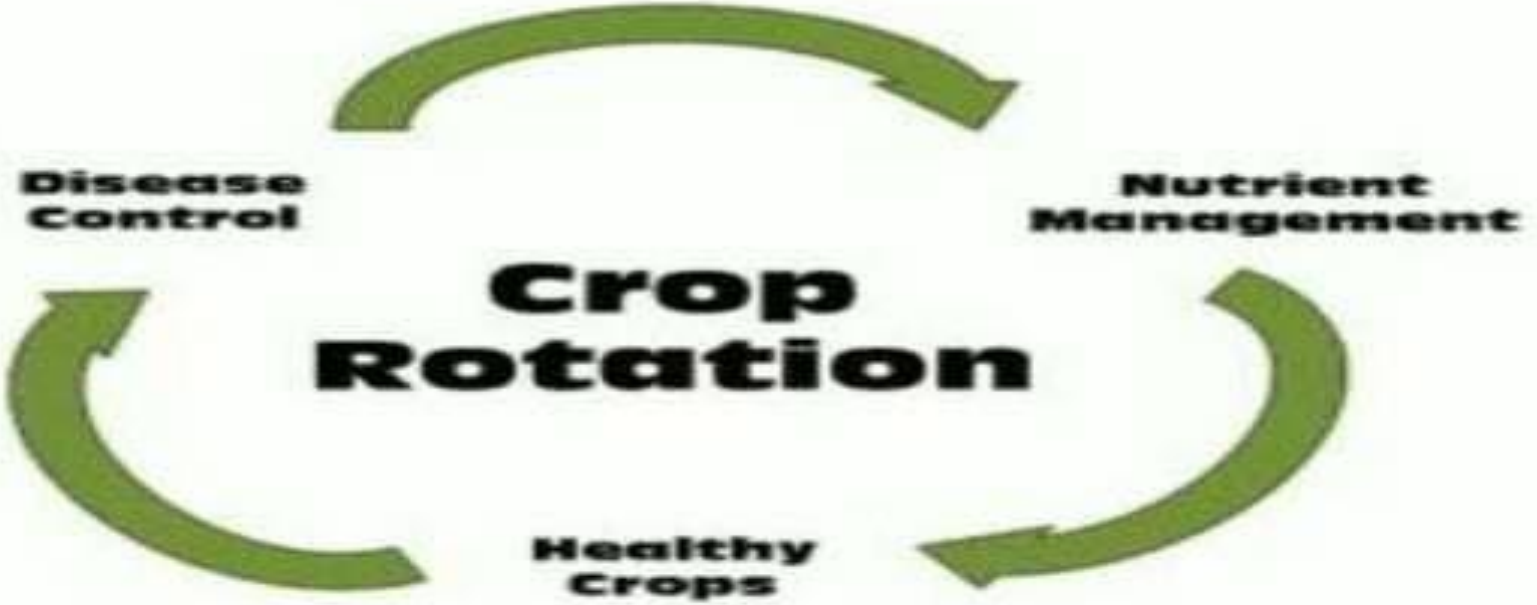
WHAT IS CROP ROTATION?

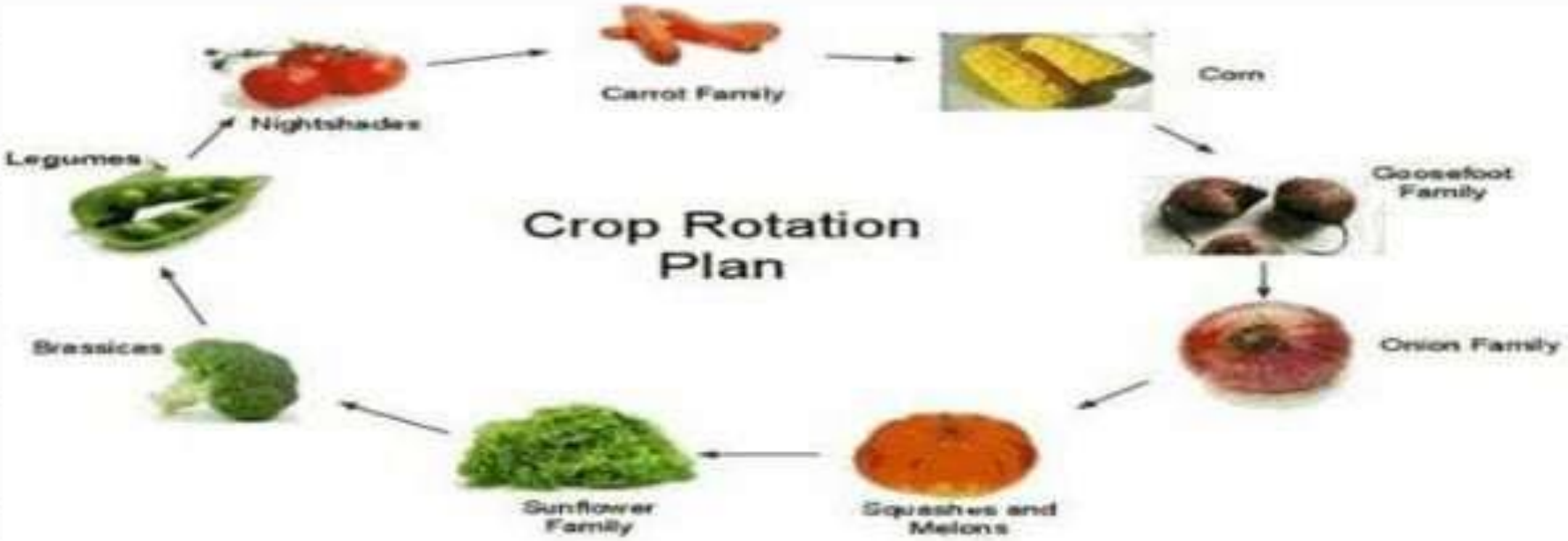
- It is the growing of different crops in succession on the same place of land over a specific period of time for getting maximum benefit with least investment and without detoriating the soil and environment.
- It may include 2-6 different crops with each crops having a particular benefit either financial or environmental.


Crop Rotation

OBJECTIVE OF CROP ROTATION

- Achieve better soil fertility and its physical, chemical and biological properties through addition of organic matters.
- Keep the soil free from disease, pest and weed through various crop and agronomical/cultural manipulations.
- Regulate continuous supply of food, feed, fodder, fibre and fuel as well as funds for various family commitments.
- Make best use of residual soil moisture and nutrients by selective crops.
- Achieve greater insurance against natural calamities and instability in market prices.
- Make best use of labour power and capital throughout the year.
- Achieve higher yield without incurring extra expenditure.


Disease Control
Nutrient Management
Crop Rotation
Healthy Crops


Nightshades
Carrot Family
Corn
Goosefoot Family
Onion Family
Squashes and Melons
Sunflower Family
Brassicas
Legumes
Crop Rotation Plan

CRITERIA FOR SELECTION OF CROPS IN ROTATION

- The crops or varieties selected should have the adaptability to the local climatic condition.
- Have demand in the market.
- Crops should have short duration.
- The inputs required for raising the crops should be available to the farmers.
- The maturity of the crops should be match with the crop demand.
- The crop variety should have to be resistant to the pest or disease.

Selection of crops for rotation

Type	Rotations
One-year rotation	1. Maize mustard
	2. Rice-wheat
Two-year rotation	1. maize-mustard-sugarcane-fenugreek (methi)
	2. Maize-potato-sugarcane-peas
Three-year rotation	1. rice-wheat-mung-mustard-sugarcane-berseem
	2. Cotton-oat-sugarcane-peas-maize-wheat

Vegetables and flowers are grown in areas close to the cities for higher income.

Crop Rotation planning considerations

Identify soil erosion, nutrient, and soil health concerns

Soil test (every 1-3 years) for pH, organic matter and nutrients. Use soil test recommendations to adjust pH and nutrient levels for optimum crop yields and quality

Determine nutrient (fertilizer manure or composts) needs

Crop Rotation planning considerations

Choose the crops/varieties to meet the erosion, soil health, nutrient concerns

Evaluate and modify the crop sequence based on the identified concerns.

Evaluate cover crop needs

Clean field equipment when moving from one field to another. Wash with water and/or physically remove the soil and plant residue from the equipment

Classical Example

An example of a successful rotation

Maize → **Cotton** → **Cowpea**

Generate residues in the rotation

Adds soil fertility

Generate cash income

PRINCIPLES OF CROP ROTATION:

- Deep rooted crops should be succeeded by shallow rooted crops such as cotton- castor, pigeon pea-potato, lentil- green gram etc
- Dicot crops should be rotated by monocot crops such as mustard-rice, potato-rice, wheat-sugarcane
- Leguminous crops should be succeeded by non-leguminous crops and vice versa (green gram -wheat).
- Exhaustive crops should be succeeded with restorative crops such as potato, sorghum, sugarcane, castor-sun hemp, black gram, and cowpea

- Foliage drop crop should be succeeded with. Non-foliage drop crops such as pulses, cotton-rice.
- Grain crops should be followed by foliage crops such as wheat, dhanicha, black gram.
- Long duration crops should be succeeded by short duration crops such as sugarcane napier. Lucerne-cowpea, black gram, groundnut.
- Field crops should be succeeded with fodder crops such as wheat, potato maize, cowpea, berseem.
- Seed crop should be succeeded with multi-cut or multi-harvest crops such as black gram, wheat, barley-lucerne, berseem and oat.

- Minimum tillage crops should be followed by deep tillage, crops such as green gram, black gram-sugarcane, potato.
- Dry crops should be followed by wet crops such as rice and sugarcane
- Crops susceptible to soil borne pathogens and parasitic weeds should be followed by tolerant trap crops such as sugarcane
- marigold (for nematodes) mustard, tobacco-rice, pulses (for orobanche), pearl millet-castor (for striga), Lucerne, berseem - oats for cuscuta),
- Crops with problematic weeds should be followed by clean crops/multi cut crops and other dissimilar crops such as wheat - puddle rice for Phalaris minor, berseem - potato for Chicorium intybus, rice - vegetables for Echinochloca crusgalli.
- Pasture crops should be followed by fodder or seed crops such as Napier grass - maize + cow-pea or oat.
- Heavy irrigation and intensive labour requiring crops should be followed by less water and labour requiring crops such as sugarcane, paddy- Mungbean and sesame

CROPPING INTENSITY AND INTENSITY OF ROTATION

- CROPPING INTENSITY –IT IS THE PERCENTAGE RATIO OF GROSS CROPPED AREA TO NET CROPPED AREA i.e., GCA/NCA %
- GCA-Sum of area under cultivation in different seasons, NCA-total land area available for cultivation
- INTENSITY OF ROTATION (R)-Year under cultivation/year under cultivation+year under fallow%
- If R ≥66%=PERMANENT FARMING
- If R ≥150%=Multiple cropping

MIXED CROPPING-

- It is the process of growing two or more crops together in the same piece of land simultaneously. The cereals are usually mixed with legumes viz.
- Jowar or Bajara mixed with Tur ,, Green gram, Black gram, Gran . Wheat is mixed with peas, gramor mustard. Cotton is grown mixed with Tur or sunflower.

INTER CROPPING-

Growing of two or more crops simultaneously on the same piece of land (field).

There is a crop intensification in both time and space dimensions.

There is intercrop competition during all or part of crop growth.

Difference between – Inter Cropping & Mixed Cropping

Sr. No	Inter Cropping	Mixed Cropping
1	The main object is to utilize the space left between two rows of main crop	To get at least one crop under favourable conditions
2	More emphasis is given to the main crop	All crops are cared equally
3	There is no competition between both crops	There is competition between all crops growing
4	Inter crops are of short duration & are harvested much earlier than main	The crops are almost of the same duration
5	Sowing time may be same or different	It is same for all crops
6	Crops are sown in different rows without affecting the population of main crop when sown as sole crop	Either sown in rows or mixed without considering the population

EFFECT OF CROP ROTATION ON SOIL:

1.On runoff and soil loss:

crop rotation of **bajra- red gram or ground nut** recorded minimum runoff and soil loss followed by **bajra-red gram-horse gram**.

2. **On biological yield:**

Legumes cereals or cereals rotation are not only beneficial for runoff but also increase biological yields.

3. **Use of crop rotations according to soil moisture:**

A- Kharif season : (shallow and poor moisture retention capacity soil)

Crop- bajra, sorghum, pulses, groundnut followed by follow

B- Rabi season:(medium to deep soil fairly good moisture retention capacity soil)

Crop- **sorghum, safflower, gram are rotated with Kharif bajra, sorghum etc.**

Advantages of crop rotation:

These are the following advantages of a crop rotation:

- Higher yield without incurring extra investment.
- Enhanced soil fertility and microbial activities.
- Avoid accumulation of toxic substances.
- Better utilization of nutrients and soil moisture.
- Insurance against natural devastation.
- Maintain soil health by avoiding insect pest diseases and weed problems.
- Provide proper labour, power and capital distribution throughout the year.
- Higher chances to provide diversified commodities.
- Slow but steady income, which is beneficial to marginal and small farmers.
- Deep rooted crops work the soil below plough layer.

Disadvantages of crop rotation :

Adopting a crop rotation **is always advantageous**. However, there are certain ill-effects of a rotation if it has not properly followed, as listed below:

- **Repetition** of some crops in rotations for many years may nullify long term benefits and may develop associated weeds and insect pest and diseases.
- Difficult to shift to crops of high demand or ethnic requirements

CROP ROTATION IS POSSIBLE UNDER CURRENT TRADE RULE IN INDIA:

- Crop rotation is very likely to continue to be an important management practice especially in the developed part of the world.
- A nearly 500% increase in energy prices and is shift from food, field and fibre crops to renewable energy crops will have an increasing impact on the land available to grow all crops and the rotation to produce them.
- Despite the difficulties associated with conducting crop rotation research ,it will be beneficial to society as a whole to support efforts in this area.


THANK YOU

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DEPARTMENT OF AGRICULURAL ENGINEERING

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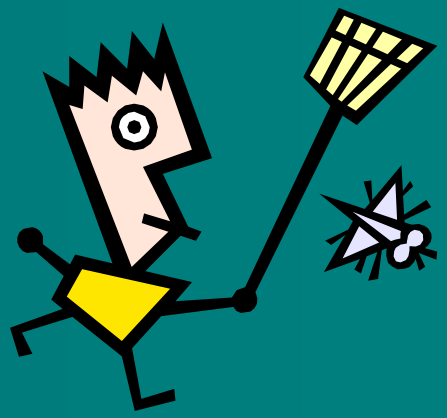
III YEAR- V SEMESTER

Integrated pest & disease managements.

Integrated Pest Management

Reducing Pesticide Use



Integrated Pest Management (IPM)

- an effective & environmentally sensitive approach to pest management
- relies on a *combination* of commonsense practices
- may include the judicious use of pesticides.

History of IPM

- Humans formed villages & started planting food crops.
- Pests became a problem - attacked them & their crops.

- Humans learned pest control - physical & cultural practices
  - tillage to expose & eliminate soil insects
  - timing of planting, crop rotation
  - pruning, dusting with sulfur

History of IPM (cont'd)

- Physical & cultural methods refined & used into the late 1800's
- Improved crop protection methods = increased acreage
- Equipment became larger & faster = larger acreage
- Monoculture replaced diversification

History of IPM (cont'd)

- ⇑ pest problems
- Search for more effective pest control measures
- The age of chemical research started:
  - Late 1900's to 1940's
- Use of physical & cultural controls ⇓
- Use of pesticides ⇑
- Pest resistance ⇑
- ⇑ pest problems

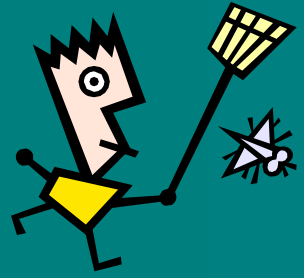
History of IPM (cont'd)

- In the mid 1940's: DDT, organochlorines, OP's & carbamates
- Led to almost total dependence on chemicals
- 1962: "Silent Spring" by Rachel Carson
- Pointed out adverse effects:
  - health, environment
- Late 1960's to 1970's:
  - Develop more benign crop protection
- 1980's - IPM principles applied to urban sites

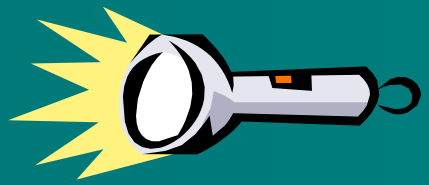
IPM

- **Goal of IPM:** control pests, not eradicate entire population
- Treatments are **not** made acc. to a predetermined schedule
- Based on results of monitoring
- Treatments are chosen & timed to be most effective & least disruptive to natural pest controls

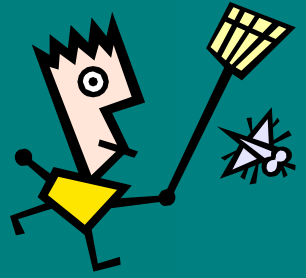
IPM Strategies



- Monitoring & identification



IPM

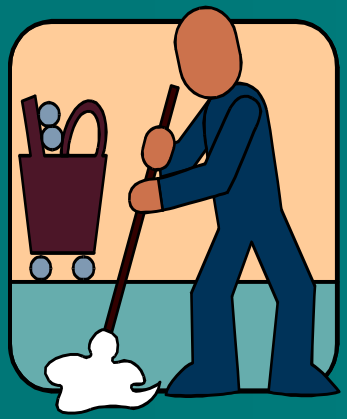


- Physical controls
  - Habitat modification
    - Exclusion
      - caulking, sealing
      - putting up screens
      - air doors

Integrated Pest Management (IPM)

- Mechanical controls

- Sanitation



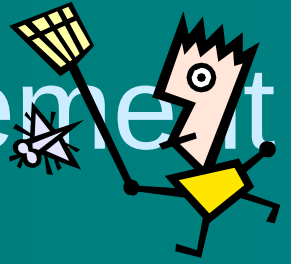
Integrated Pest Management (IPM)

- Cultural controls, for example-

To maintain a healthy lawn:

- Develop healthy soil.
- Choose the right grass type.
- Mow high, often.
- Water deeply.
- Reduce thatch build-up.
- Set realistic goals.

Integrated Pest Management (IPM)



- Biological controls - Bt, nematodes, parasitic wasps, beneficial insects

- Least hazardous pesticides used only when absolutely necessary.

  For example:
  - Baits - gel, tamper-proof containers

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Organic pesticides, bio-pesticides.

- **Organic Pesticides**
- Organic pesticides are substances derived from natural sources (like plants, minerals, or other organisms) that are used to control pests in agriculture and gardening. They are often used in organic farming practices because they tend to be less harmful to the environment and humans than synthetic chemical pesticides.

- **Examples**:**Neem oil**: Extracted from the neem tree (*Azadirachta indica*), it is widely used to repel a variety of insects.
- **Pyrethrins**: Naturally derived from chrysanthemum flowers, pyrethrins are used to target insects.
- **Diatomaceous earth**: A powder made from fossilized algae, it is used to damage the exoskeletons of insects, causing dehydration.

- **Bio-pesticides**
- Bio-pesticides are a subset of pesticides that come from natural materials, such as animals, plants, bacteria, and certain minerals. They are used for pest management and are often highly specific, meaning they target specific pests without affecting other organisms.
- **Types of Bio-pesticides**:
  - **Microbial Pesticides**: Use microorganisms (e.g., bacteria, fungi, viruses) as active ingredients to control pests. *Bacillus thuringiensis* (Bt) is a common microbial pesticide that produces toxins that kill specific insects.
  - **Plant-Incorporated Protectants (PIPs)**: Plants are genetically modified to produce pesticidal substances. For instance, Bt corn has been modified to produce Bt toxin that repels certain insects.
  - **Biochemical Pesticides**: Naturally occurring substances that control pests by non-toxic mechanisms, such as insect sex pheromones that disrupt mating.

- **Inorganic Pesticides**
- Inorganic pesticides are chemical compounds that do not contain carbon-hydrogen bonds and are typically derived from minerals or metals. Unlike organic or bio-pesticides, these are synthesized from naturally occurring mineral compounds and are used in agriculture, pest control, and gardening.
- **Examples of Inorganic Pesticides:**
- **Arsenic Compounds**:
  - *Arsenic trioxide* and *lead arsenate* were widely used in the past but have been banned in many places due to their toxicity.
- **Copper Compounds**:
  - *Copper sulfate* is commonly used as a fungicide in vineyards and on other crops.
- **Sulfur Compounds**:
  - *Sulfur* has been used as a pesticide and fungicide for many years.
- **Mercury Compounds**:
  - *Mercuric chloride* was once used as a fungicide and insecticide but is now banned in most countries due to its extreme toxicity.
- **Boric Acid**:
  - A mild inorganic pesticide used to control insects like ants, cockroaches, and termites.

- **Disadvantages of Using Inorganic Pesticides**
- While inorganic pesticides can be effective in controlling pests, their use comes with significant disadvantages:
- **Environmental Persistence**:
  - Many inorganic pesticides, especially those containing metals like arsenic and mercury, do not break down easily in the environment. This leads to long-term contamination of soil, water bodies, and ecosystems, which can harm non-target species and even disrupt entire food chains.
- **Toxicity to Non-Target Organisms**:
  - Inorganic pesticides often lack the specificity of bio-pesticides, meaning they can harm beneficial insects, wildlife, and even humans. For example, copper and sulfur compounds can damage plant tissues or affect beneficial microbes in the soil.
- **Human Health Risks**:
  - Some inorganic pesticides, such as arsenic and mercury-based compounds, are highly toxic and carcinogenic to humans. Prolonged exposure or accidental ingestion can lead to severe health problems, including cancer, nervous system damage, and respiratory issues.
- **Bioaccumulation**:
  - Heavy metals like mercury and arsenic can accumulate in the tissues of living organisms. This bioaccumulation increases as you move up the food chain, potentially leading to dangerous concentrations in predators, including humans who consume contaminated plants or animals.
- **Soil and Water Contamination**:
  - Inorganic pesticides can leach into groundwater and contaminate drinking water sources, making them unsafe for consumption. Soil contamination can also reduce fertility and disrupt microbial communities essential for plant health.
- **Development of Resistance**:
  - Over time, pests can develop resistance to inorganic pesticides, requiring higher doses or new, potentially more harmful chemicals to achieve the same level of pest control.
- **Limited Biodegradability**:
  - Unlike organic or bio-pesticides, inorganic pesticides do not biodegrade easily, which means they can remain in the environment for long periods, posing long-term risks.

Detailed Accounting Of Different Protection Technologies Like Seed- Dressing , Seed-soaking and Root Dip Treatment

BY :- JAYANT YADAV, CCS HARYANA AGRICULTURAL UNIVERSITY, HISAR

What is a seed treatment?

- "Chemical or biological substances that are applied to seeds or vegetative propagation materials to control disease organisms insects, or other pests. Seed treatment pesticides include bactericides, fungicides, insecticides, and herbicide antidotes (safeners)."

Historical Aspects

- The earliest reported use of seed treatment dates back to 60 A.D. when wine and crushed cypress leaves were used to protect seed from storage insects

- In 1807, the Swiss scientist Prevost showed that treating smut spores with a liquid solution of copper sulphate inhibited their germination.

Advantages of Seed treatment-

1) Prevents spread of plant diseases.
2) Protect seed from seed rot and seedling blight.
3) Improves germination.
4) Provides protection from storage insects.
5) Control soil insects.

Disadvantages:

- Accidental exposure of workers who produce or apply seed treatments.
- Contamination of the food supply by accidental mixing of treated seed with food or feed grain.
- Accidental contamination of the environment through improper handling of treated seeds or seed treatment chemicals.

"All of these risks can be minimized by proper training and proper use of seed treatment pesticides"

Equipment for seed treatment

EQUIPMENTS

1.Drum Mixer:

•This equipment is used for different kind of seeds with chemicals in powder form.

•Seed treatment drum is made up of angle, iron frame and G.I sheet made drum.

•In one batch 10-15 kg seed can be treated with chemicals.

2. Slurry treaters

- The slurry treatment principal involves suspension of WP treatment material in water.

- The treatment material applied as slurry is accurately metered through a simple mechanism composed of a slurry cup and seed drum pan.

- The cup introduces a given amount of slurry, with each dump of seed, into a mixing where the seeds are mixed thoroughly.

- The slurry treaters are adoptable to all types of seeds and rates of seed treating.

Slurry treater

3. Direct Treaters

- Direct treaters are the most recent development and incude the Panogen and Mist-o-matic treaters.

- Mist-o-matic treaters is being used more widely.
- The Mist-o-matic treater applies chemical as a mist directly to the seed.

- The treater is equipped with a large treatment tank , a pump and a return that maintains the level in the small reservoir from which the seed is feed.

4.Grain Auger:

Liquid materials can be dripped on the seed as they enter a grain auger.
By the time seeds have left the auger the chemical is spread on the seeds.

5.Shovel:

- Seeds are spread on a clean dry surface 10-15cm in depth.
- The proper amount of chemical is diluted with water and sprinkled over the seed.
- Mixing is done with shovel turning the seed at least 20 times

Seed dressing techniques in Patholgy

- The talc based formulation (with 28 X 10^6cfu/g product*) of* *T. viridi* is used as dry seed treatment @ 4g/kg of seeds. For the control of root rot disease of black gram, Green gram ,chick pea , groundnut sunflower & cotton.

Rice

Rice blast : *Pyricularia grisea*

Seed treatment with binomyl + thiram @ 2g/kg .

Brown spot : *Bipolaris oryzae*

Seed dressing with Organo murcurial fungicide like agrosan GN or thiram @2g/kg

Wheat

- Loose smut of wheat ,Flag smut & Karnal Bunt: Vitavax or Bavistin 2g/kg or Tebucanazonole (Raxil – 2DS) @ 1g/kg

Chickpea :

Fusarium wilt : *Fusarium oxysporium f.sp. cicer*

Trichoderma viridi (Bioderma)@4g + 1g Vitavax /kg of seed

Mustard :

Sclerotinia stem rot: *Sclerotinia sclerotiorum*

Carbendazim @2g/kg of seed.

Vegetable & spices

Potato black scruf : *Rhizoctinia solani*

Seed treatment with boric acid (3%), spray before cold storage *or* *T. viridi* before planting.

Common scab : *Streptomyces scabbies*

Seed treated with boric acid 3%.

Tomato :

Damping off ; *Phytopthora* species & *R.* spp.

Dry seed treatment with captan or thiram 3g/kg of seed.

Wilt : *Fusarium oxysporum*

Seed treatment with Bavistin 2.5g/kg of seed

Leaf mosaic : Tomato Mosaic Virus(TMV)

Seed treatment with Trisodium phosphate solution 20%.

Corriander

Corriander stem gal : *Protomyces macrosporus*

Seed treatment with Captan & Thiram @ 4g/kg of seed.

Cumin

Cumin wilt : *Fusarium oxysporum*

Seed treatment with Bavistin @ 2g/kg of seed.

Seed dressing techniques in Nematology :

The most common systamatic nematicide viz. Fenamiphos, Isofenphos, Carbosulphan etc. are used at 2-3% w/w.

Seed dressing with carbosulphan (Marshal 25 ST) at 3% w/w is quite effective for managing RKN in okra , Bottle gourd, Bitter gourd & jute

- Rice white tip Nematode, *Aphelenchoides besseyi*

Seed tereatment with carbosulfan 25EC @0.1 % for 12 hrs.

Seed dressing techniques in Entomology :

Sorgham Shoot Fly : *Atherigona soccata*

Seed coating with isofenphos 5G @30g/100g provides protection against shoot fly upto 2 weeks.

Wheat termite : *Odentotermus obesus & Microtermus obesi*

Seed treatment with chlorpyriphos 20 EC @ 4ml/kg of seed.

White grub : *Holotrichia consanguinea*

Seed treatment of groundnut kernel with chlorpyriphos 20EC @ 12.5ml/kg .

Cotton jassid : *Amrasca biguttula biguttula*

Seed treatment of okara with imidacloprid 70WS@5g/kg.

Potato tuber moth : *Pthorimaea operculella*

By dusting seed potato with 150g of alathion 2% per 100kg seed.

Management of storage pest :

Seed treatment : The grain ment for seed can be protected by mixing with malathion (5%) @ 250g/qt of seed or malathion 50EC @ 25 ml /qt of seed.

Seed soaking:

Seed soaking techniques in Pathology

Clusterbean :

Bacterial leaf blight :

Take 6g streptocycline + 6kg of seed + 6L of water& dipped for 1-2 hours & after that dry in shade for 30-40 min.

Rice becterial leaf blight :

Soaking the seed in agromycin (0.025%) for 8 hrs& cresan (0.1%) followed by hot water treatment for 30 min at 52-54^{0}C.

Rice blast :

Soak the seeds for 24 hrs in 1 g/L carbendazim 50WP (bavistin ,dersol) prior to sowing in the nursury .

Seed soaking technique in nematology

- Seed soaking with dimethoate, carbosulfan (Marshal 25 EC) can also be adopted for providing better crop with early protection against nematodes.

- Rice RKN: *Meloidogyne graminicola*
  Seed soaking with carbosulfan (marshal 25 EC)@ 500 ppm or carbosulfane @ 0.1% for 12 hrs.

- Rice Root nematode : *Hirschmaniella* spp.
  Seed soaking with carbosulfan 25 EC or isofenphos @ 0.2% for 6 hrs.
- Rice cyst nematode : *Heterodera oryzicola*
  Soaking of seed with phenamiphos @ 0.02% for 6 hrs
  .

White tip nematode: *Aphelenchoides besseyi*

This practice is widely used for controlling white tip nematode disease in rice in south India.
Seeds are dipped in hot water (54-55^{0}C) for 10-15min.

- *Aphelenchoides besseyi* also reported on Tuberose.
- ✓Pre soaking of tuberose in plain water or in 4% NSKE for over night followed by dipping in monocrotophos 36 SL at 500ppm for 4-6 hrs.

Root dip treatment

Root dip technique technique in pathology :

- Rice tungro : Seedling should be dipped in carbofuran 75WP (30g of carbofuran in 10ltr water)before planting.

- Rice blast : Root dip treatment of the seedling immediately after uprooting for 12hrs in 0.1% carbendazim 50WP solution.

Root dip technique in nematology :

- Rice RKN :
- Bare root dipping in carbosulfan (Marshal 25EC) @ 500 ppm for 20 min.

- Rice root nematode :
- Bare root dip treatment with carbosulfan 25EC /monocrotophos 36EC @ 1000-2000 ppm for 20-30 min.

Root dip techniques in entomology

- Rice :

  Paddy gall fly : *Orseolia oryzae*

  For gall midge endemic areas ,seedling root dip in 0.02% emulsion of chlorpyriphos for 12 hrs before transplanting protect the crop for 25-30 days

- Banana :

  Banana weevil : *Cosmopolites sordiculus*

  suckers should be dipped in 0.1% quinalphos emulsion before planting

Chemical treatments to improve germination and vigour potential

Examples

- Paddy

  Seeds can be soaked in 1% KCl solution for 12hrs to improve the germination and vigour potential.

- Sorghum

  Seeds can be soaked in $NaCl_2$ (1%) or Kh_2Po_4 (1%) for 12hrs for improving the germination and vigour potential.

- Pulses

  Seeds can be soaked in $ZnSo_4$, $MgSo_4$ and $MnSo_4$ 100ppm solution for 4 hrs to improve the germination and vigour potential.

Precauation for seed teatment

- Never used for animal or human consumption.
- The treated seeds must be properly labelled.
- Care must be taken to treat the seeds at correct dosage.
- The technique must be economical and practical for the specific crop ,and above all the materials used should be environmentally safe.

THANK YOU

Feasibility of Complete Dependence on Organic Sources

Relying completely on organic sources, particularly in agriculture and pest management, has garnered a lot of interest as it promises healthier food systems, environmental sustainability, and reduced chemical pollution. However, the feasibility of completely depending on organic sources, such as organic farming and bio-based pest control, needs to be carefully evaluated by considering several factors.

fertilizers, organic farming reduces water pollution, lowers the risk of soil degradation, and promotes biodiversity by providing habitats for beneficial organisms like pollinators.

Healthier Food Production:

Organic farming produces food free of synthetic pesticide residues, which can be harmful to human health. Organic foods also tend to be fresher and may contain higher levels of certain nutrients and antioxidants.

Reduced Dependence on Non-renewable Resources:

Organic farming minimizes the use of fossil-fuel-based synthetic fertilizers and pesticides. Instead, it relies on natural cycles, such as crop rotation, green manure, and natural predators for pest control, making it more sustainable in the long term.

Improved Soil Health:

Organic farming practices enhance soil structure, fertility, and microbial activity, leading to better long-term agricultural

composting, and natural pest management. This can increase production costs, making organic products more expensive for consumers and less profitable for farmers unless there is sufficient demand and price premium for organic products.

Supply Chain and Certification Issues:
Organic farming requires strict adherence to certification guidelines and standards. Maintaining organic certification can be costly and complicated for small-scale farmers. Additionally, organic supply chains are often underdeveloped in some regions, making it harder for farmers to access organic seeds, fertilizers, and markets.

Nutrient Deficiency in Soils:
In regions with poor or degraded soils, organic farming may not be able to provide sufficient nutrients for optimal crop growth. Organic fertilizers are slower to release nutrients compared to synthetic ones, and over time, organic farms may face nutrient depletion issues