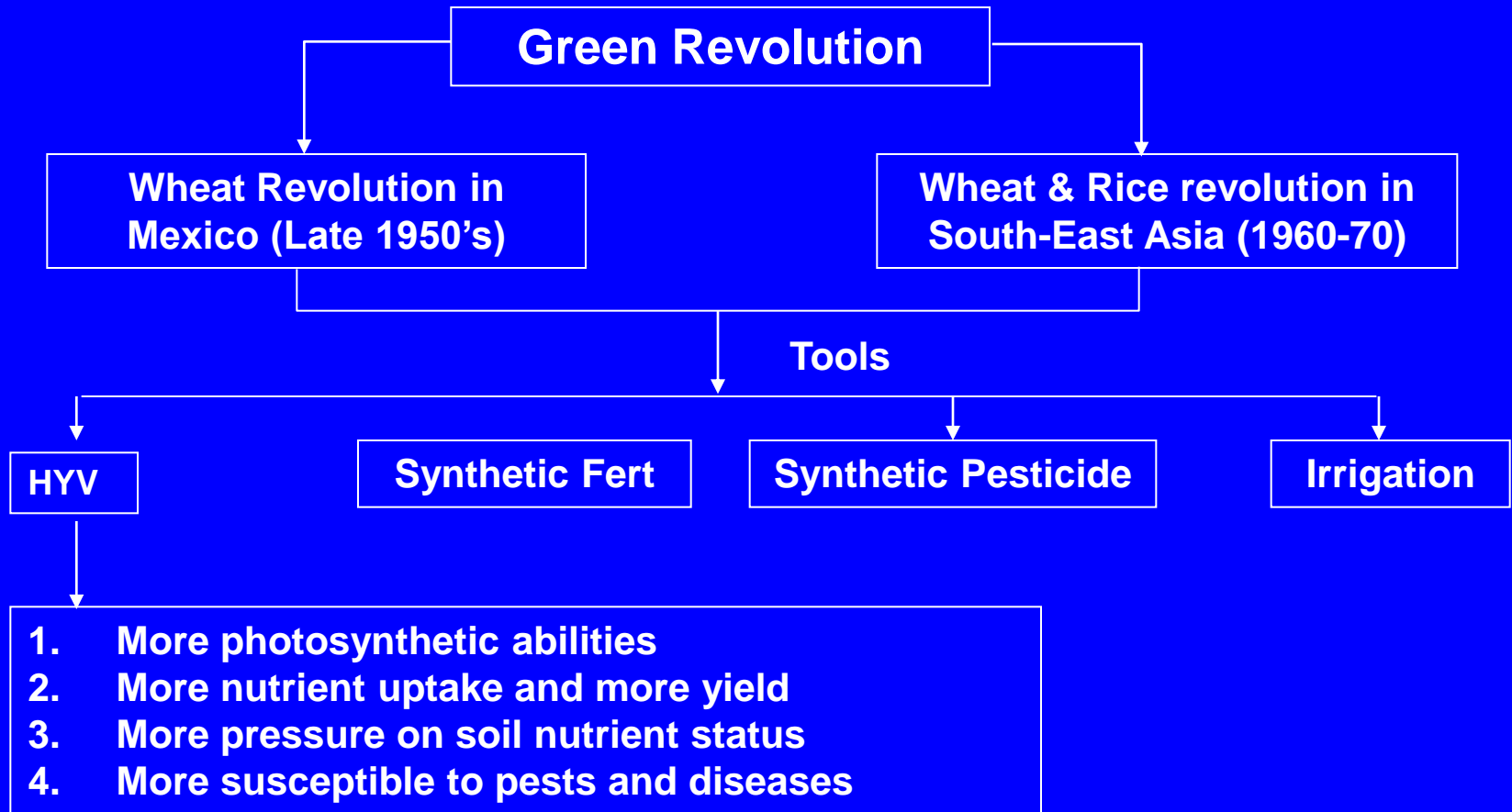


**ORGANIC FARMING**

**FOR**

**SUSTAINABLE CROP PRODUCTION**

*Dr. B. Kalita*  
*Department of Agriculture, Assam*



# **Three major events led to chemical input intensive revolution in Agriculture**

- 1. Successful synthesis of  $\text{NH}_3$  by Fritz Haber (1907)**
- 2. Discovery of remarkable insecticidal power of DDT by Dr. Paul Muller (1939)**
- 3. Introduction of dwarfism from
  - i. Norin-10 into Mexican wheat by Norman Borlaug (1954) and**
  - ii. Dee-geo-woo-gen into tall Indonesian rice variety at IRRI (1966)****

# **GREEN REVOLUTION**



A vertical line descends from the underlined title 'GREEN REVOLUTION'. From this line, five horizontal arrows point to the right, each pointing to a text label. The labels are stacked vertically from top to bottom: 'Chemical fertilizers', 'Chemical Pesticides', 'HYV', 'Irrigation', and 'Mechanization'.

**Chemical fertilizers**

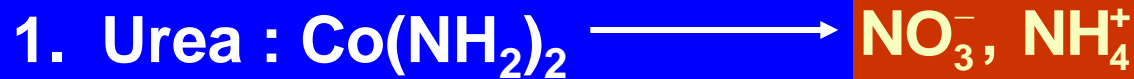
**Chemical Pesticides**

**HYV**

**Irrigation**

**Mechanization**

# SYNTHETIC FERTILIZER (Example of adverse affects)



Free radicals from urea application -----  $\text{NO}_3^-$   $\longrightarrow$  harmful

Haematoglobimeia (Blue disease syndrome)  
>10 ppm  $\text{O}_2$  carrying capacity decreases

Free  $\text{NO}_3^-$  accumulation in animal cells

$\text{NH}_2\text{NO}$  (Nitrosamine)  
(Carcinogenic affect)

Use of chemical fertilizer leads to  
imperfectly synthesized protein in leaves



Many diseases in plants, animals and  
human beings

*Source : Soil and Health (1931) by Sir Albert*

# **Harmful effect of Chemical Fertilizer**

**Glasgow university scientists (1993)**



**Found link between levels of nitrate in vegetables and gullet cancer due to increase use of nitrate fertilizer since world war II.**

## **2. LEAD AND CADMIUM CONTENT INFERTILIZER (ppm) :**

<b>Fertilizer</b>	<b>Lead</b>	<b>Cadmium</b>
<b>Urea</b>	<b>4</b>	<b>1</b>
<b>SSP</b>	<b>609</b>	<b>187</b>
<b>DAP</b>	<b>188</b>	<b>109</b>
<b>RP</b>	<b>1135</b>	<b>303</b>
<b>MOP</b>	<b>88</b>	<b>14</b>



# SYNTHETIC PESTICIDE

## (Example of adverse affects)

(i) DDT – During 2<sup>nd</sup> World War Paul Mullar (British) – Insceticidal property.



Norman Moore (British Scientist) was first to suggest that decline of Eagles was due to the then popular insecticide – DDT



Rachel Carson did much to popularize Moore's theory that there was price to pay for using chemicals to grow food.



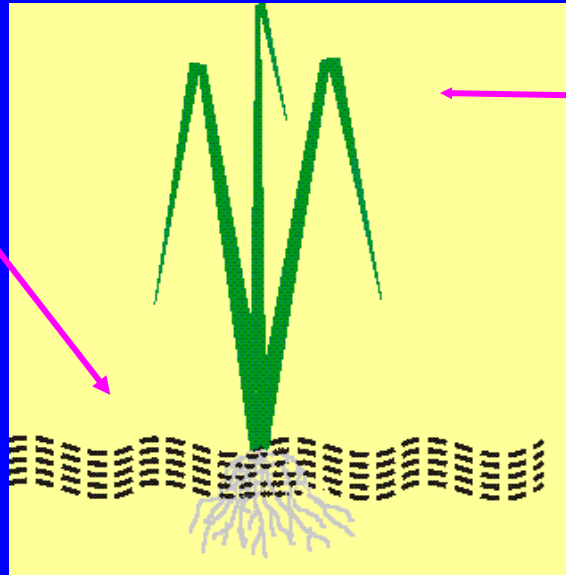
DDT (Bio-magnification) progressive concentration

0.02 ppm in water → 5 ppm in plankton → 40 – 300 ppm in plankton eating fish → up to 2500ppm in carnivorous species

# Silent Spring (Book)– by Rachel Carson

In California – Lake – DDT was used to repel / kill mosquito – aquatic plants absorbed DDT – Duck ate aquatic plants – Population drastically reduced due to Biomagnification.

(ii) Furadon 3 G



Hispa / Stemborer

Fish

Frog

Earth worm

Dead



Heron → Fox → Vulture

# **Overall adverse affects of pesticides-**

- 1. Weakness of nervous system**
- 2. Stomach disorder**
- 3. Fatal disease like cancer**
- 4. Chain wise adverse affect on animal Kingdom**
- 5. Affect on activity of soil micro & macro organisms.**
- 6. Sterility**
- 7. Asthma**
- 8. Skin disorder**

**Now, what is the answer?**

# Organic Farming

## **ORGANIC FARMING :**

**Organic farming is a unique production management system which promotes & enhances agro-ecosystem health, including biodiversity, biological cycles & soil biological activity and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs.**

## **OBJECTIVES OF ORGANIC FARMING :**

- 1. To produce food of high nutritional quality in sufficient quantity.**
- 2. To work with natural system with more scientific design in order to leave a living soil for our next generations.**

# SCOPE OF ORGANIC FARMING IN N.E. STATES

## CONSUMPTION OF PLANT NUTRIENTS AND PESTICIDES IN N.E. STATES

State	Plan nutrients (Kg/ha) 2001-02			Consumption of pesticides (Tones)
	N	P	K	
Arunachal Pradesh	1.56	0.90	2.88	42
Assam	19.18	10.56	38.81	630
Manipur	86.54	12.00	104.94	42
Meghalaya	10.52	6.16	17.16	19
Mizoram	4.94	5.16	13.72	13
Nagaland	1.12	0.85	2.13	NA
Sikkim	5.05	3.49	9.72	-
Tripura	16.55	8.63	30.46	100
Average	18.83	9.07	35.04	141
Average India	58.72	22.75	90.12	80,659

## Fertilizer use (India)



Up to 1906 no. chemical fertilizer was used in India

1950-51	-----	0.5 Kg/ha	INDIA
2007-08	-----	104.5 Kg/ha	
2007-08 (Assam)	-----	58.6 Kg/ha	

## PESTICIDES CONSUMPTIONS :

India	-----	0.448 Kg/Ha
Japan	-----	10-12 Kg/ha
USA	-----	8-10 Kg/ha
Assam	-----	40.46 gm/ha



## Chemical analysis of Soil samples collected from the farmers fields under organic and conventional farming systems

Characteristics	Organic sources*		Integrated nutrient use**		Chemical fertilizer ***	
	Depth (cm)		Depth (cm)		Depth (cm)	
	0-7.5	7.5-15.0	0-7.5	7.5-15.0	0-7.5	7.5-15.0
PH (1:2.5)	7.25	7.25	7.41	7.43	7.51	7.51
Organic carbon (%)	0.60	0.58	0.53	0.52	0.41	0.39
Available N (kg ha <sup>-1</sup> )	256	255	224	222	185	184
Available P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> )	49	49	42	41	29	28
Available K <sub>2</sub> O (kg ha <sup>-1</sup> )	458	459	477	470	426	427
Mineral (ug g <sup>-1</sup> )	70.37	66.00	57.33	54.66	46.28	44.43

\* Average of 8 soil samples; \*\* Average of 6 soil samples; \*\*\* Average of 7 soil samples

*Source : Anonymous (2002)*

# Microbiological analysis of Soil samples collected from the farmers fields under organic and conventional farming systems

Characteristics	Organic sources*		Integrated nutrient use**		Chemical fertilizer ***	
	Depth (cm)		Depth (cm)		Depth (cm)	
	0-7.5	7.5-15.0	0-7.5	7.5-15.0	0-7.5	7.5-15.0
Soil microbial biomass C (mg kg <sup>-1</sup> soil)	272	264	235	229	220	214
Soil microbial biomass N (mg kg <sup>-1</sup> soil)	39	37	34	31	30	27
Dehydrogenase activity (ug TPF g <sup>-1</sup> soil 24 hr <sup>-1</sup> )	54	51	45	42	35	31
Acid phosphatase activity (ug TPF g <sup>-1</sup> soil 24 hr <sup>-1</sup> )	629	613	603	590	558	543
Azotobacter (10 <sup>3</sup> g <sup>-1</sup> )	12.7	10.5	6.3	5.3	0.9	0.6
P-solubilizing bacteria (10 <sup>5</sup> g <sup>-1</sup> )	9.1	8.8	6.5	6.2	3.2	2.9
Actinomycetes (10 <sup>5</sup> g <sup>-1</sup> )	26.7	22.9	18.3	16.	1.8	1.2
Fluorescent pseudomonas (10 <sup>5</sup> g <sup>-1</sup> )	22.3	19.9	13.3	12.1	9.9	9.1

# Yields and economics of organic farming vis-à-vis conventional farming

Year	Status	Yield q ha <sup>-1</sup>	Gross income (Rs.)	Premium (20%)	Total (Rs.)	Net income (Rs.)	Surplus/ deficit over conventional (Rs.)
Conventional	-	10	20000	0	20000	9000	0
First year	Year of conversion	5	10000	0	10000	750	-8250
Second year	Year of conversion	5.75	11250	0	11250	3750	-5250
Third year	Organic	6.25	12500	2500	15000	7000	-1500
Fourth year	Organic	7.50	15000	3000	18000	10500	1500
Fifth year	Organic	8.75	17500	3500	21000	13500	4500
Sixth year	Organic	10.00	20000	4000	24000	16500	7500

*Central Institute for Cotton Research, Nagpur*

*Source: Rajendran et. al. (2000)*

## **Advantages of Bio-fertilizers**

- i. 20-50% chemical N replacement**
- ii. 15-25% synthetic P replacement**
- iii. 10-40% grain yield increase**
- iv. 15-30% vegetative growth**

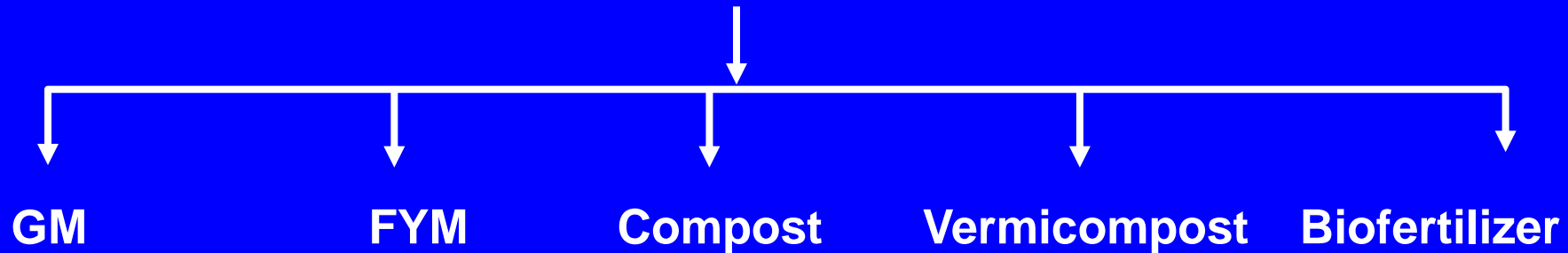
# Nutritional Aspects of Organic Produce

Percent change in nutrient components in Organic over conventional produce

Nutrient	% difference in organic over conventional	Remarks
Vitamin C	+22.7	Compiled from a review of 1230 published reports in Britain, Europe and USA (1999).  Ref. : Organic Agriculture-Philosophy and Science- -By Dr. A.K.Yadav et al.(2006)
Iron	+17.2	
Calcium	+30.8	
Phosphorus	+12.5	
Sodium	+19.6	
Potassium	+14.1	
Magnesium	+24.4	
B-carotene	-00.3	
Nitrates	-33.9	

N.B. : Keeping the values of conventional produce at 100

# SOIL FERTILITY MANAGEMENT IN ORGANIC FARMING



## GREEN MANURING CROPS (45-60 days)

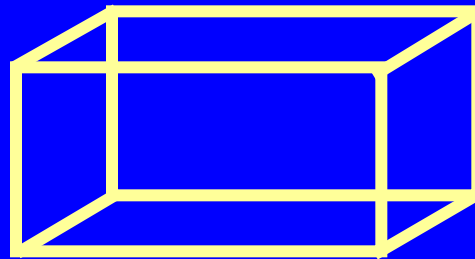
Sl. No.	Crops	Organic matter addition (Kg/Bigha)	N <sub>2</sub> -fixation (Kg/ha)
1.	Sun hemp ( <i>Crotolaria juncea</i> )	2825.0	55.0
2.	Dhainsa – <i>S. acculeata</i>	2020.0	86.0
	( <i>Sesbania</i> ) <i>S. rostrata</i>	2400.0	120.0
3.	Green gram	1065.0	25.0
4.	Cowpea	2000.0	37.0
5.	Lathyrus	1640.0	40.0

# VERMI COMPOST :

Important verms are :

1. Eisenia faetida
2. Eudrillus euginae
3. Perionyx excavatus

Length = 10 feet  
Breadth = 3 feet  
Depth = 2-2.5 feet



Ratio of cowdung and agro-waste = 40:60

Average nutrients contents in vermicompost

N	-----	2.5-3.0%
P <sub>2</sub> O <sub>5</sub>	-----	1.0-1.5%
K <sub>2</sub> O	-----	1.5-2.0%

## HORMONAL EFFECT

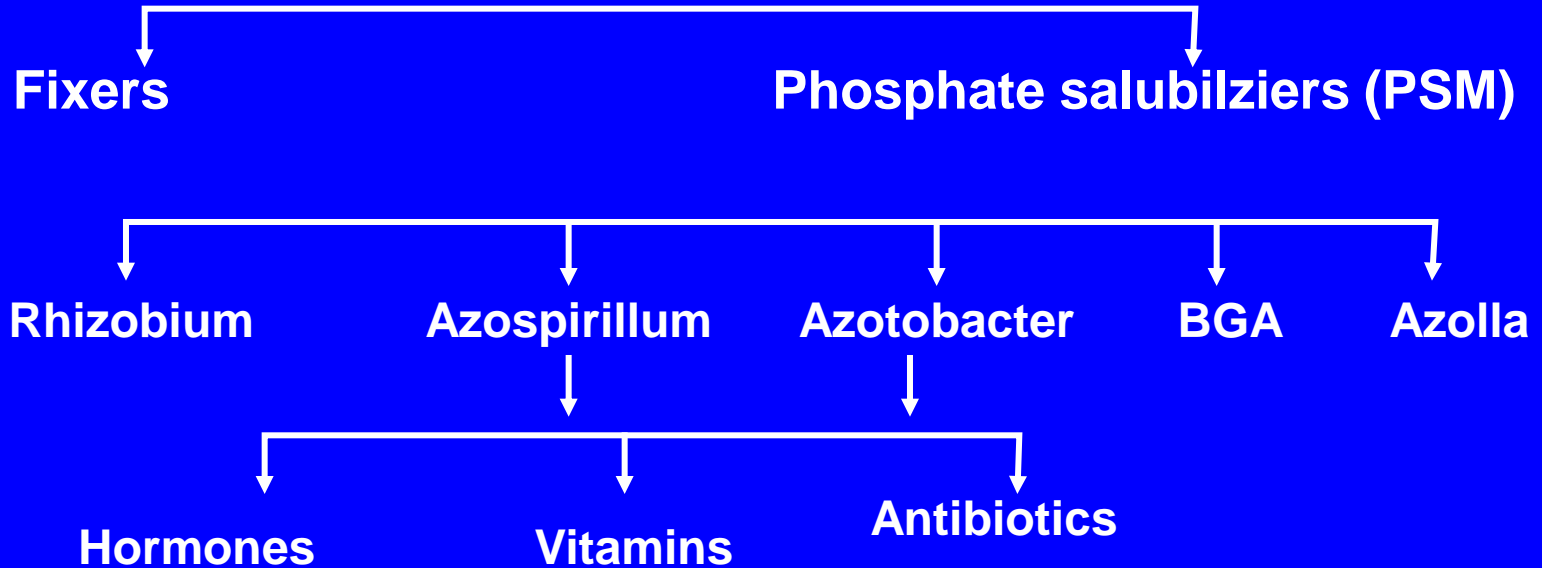
Better plant and root growth



**AN IDEAL VERMI COMPOST PRODUCTION UNIT**



# BIO-FERTILIZERS



## Azospirillum

- (1) Heterophilic micro-aerophilic bacteria
- (2) Prefers to proliferate on root surface (Rhizosphere)
- (3) May enter into roots and survive in root cortex.
- (4) Excess fixed  $N_2$  is released on the root surface or inside the root tissue
- (5) Associative symbiotic relationship → Less chance of leaching loss and utilization by other micro organisms.

## Azotobacter:

- (1) Hetero-trophic aerobic bacteria
- (2) It is free living
- (3) Prefers to thrive mainly in soils close to roots.

# Important points for application of Azotobacter and Azospirillum Biofertilizer :

## Soils

- |    |  |   |              |
|----|--|---|--------------|
| 1. | Upland well aerable soil with light to medium texture        | → | Azotobacter  |
| 2. | Upland, medium land or low land with medium to heavy texture | → | Azospirillum |

## Azotobacter / Azospirillum

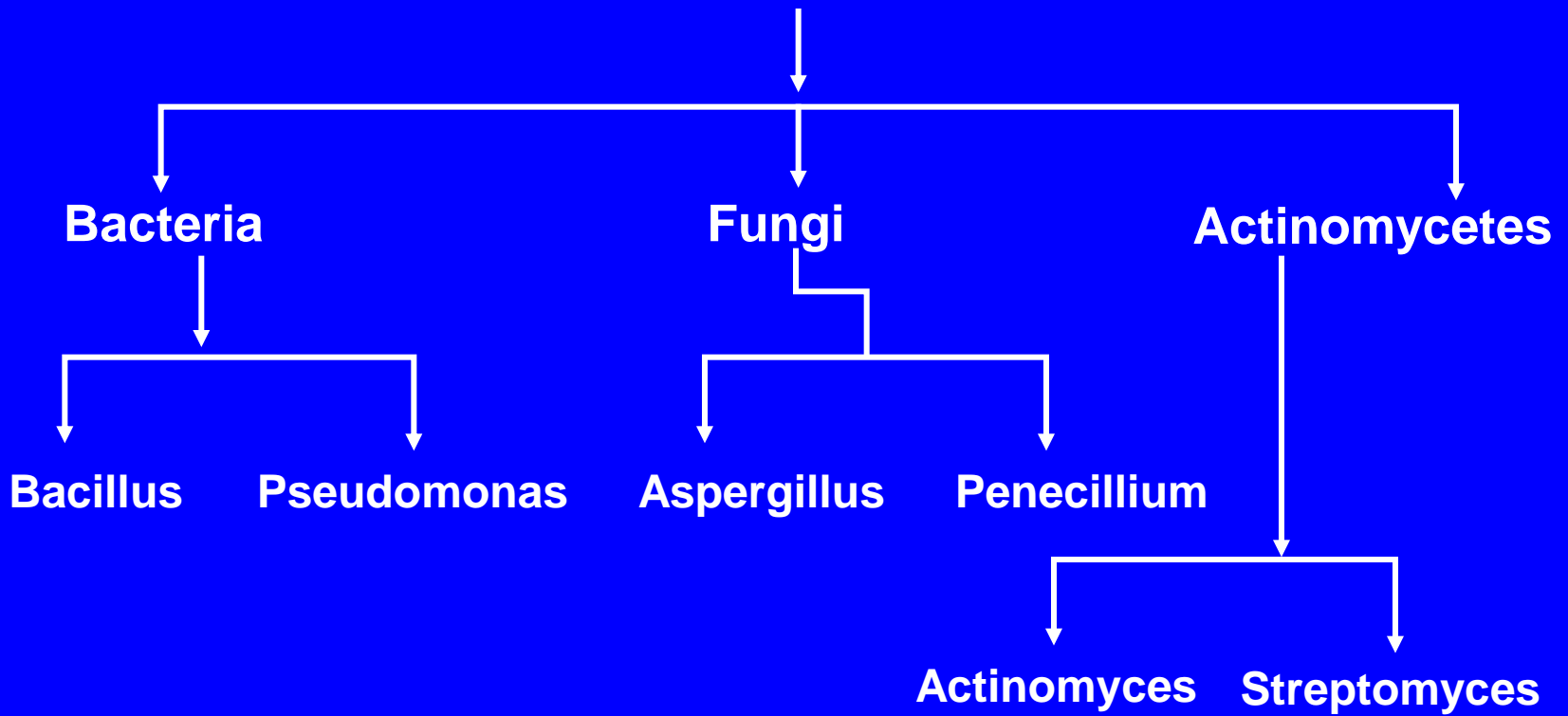
## Crops

- |    |  |   |                               |
|----|--|---|-------------------------------|
| 1. | Vegetable and cash crops like cotton, mulberry | → | Azospirillum                  |
| 2. | Upland rice                                    | → | Azotobacter /<br>Azospirillum |
| 3. | Medium to low land rice                        | → | Azospirillum                  |
| 4. | Fruit plants & plantation crops                | → | Azotobacter                   |

# PSM

1. **Bacillus, Pseudomonas** → **Mild acidic to neutral soil**
2. **Aspergillus  
Penicillium** → **Low pH**

# PSM



# PSM



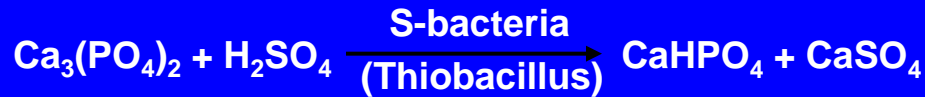
- 1. Grow vigorously in the rhizosphere region of the roots**
- 2. High requirement of carbon source**
  - > Derive their food from roots exudates
- 3. Develop associative symbiotic type of relationship with plants**
- 4. Secrete extra cellular metabolites such as  $\text{CO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  & Organic acids and help in Phosphate solubilization**

# Reactions involved in phosphate solubilization.

## 1. CO<sub>2</sub> solubilization



## 2. Mineral acid solubilization



## 3. H<sub>2</sub>S Solubilization



## 4. Organic acid solubilization

Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>  
Fe-PO<sub>4</sub>  
Al-PO<sub>4</sub>

Organic acids-  
Citric acid, oxalic, lactic,  
malic, tartaric, α-Ketoglutaric

CHELATION

Metallo-organic  
Molecules

H<sub>2</sub>PO<sub>4</sub><sup>-</sup> or HPO<sub>4</sub><sup>-</sup>

Released

(Stable organic complexes of  
Ca<sup>++</sup>, Fe<sup>+++</sup> and Al<sup>+++</sup>)

# APPLICATION OF BIO-FERTILIZER

## 1. Seed treatment

10 kg seed +200 g Azotobacter / Azospirillum + 200 g Phosphatika + 300 — 400 ml rice starch water + 100 g lime powder for acid soil



**Mix well and sow**

# SEEDLING ROOT DIP TREATMENT

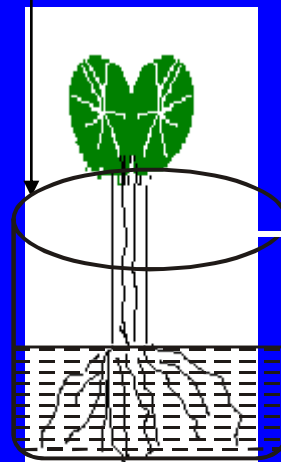
(A) Vegetables

(B) Paddy

1 kg Azotobacter / Azospirillum  
+ 1 Kg Phosphatika

For 1 acre  
of land

Dip seedlings for  
about 30 minutes



Vegetable seedlings  
(in bundles)

5-8 litres of water

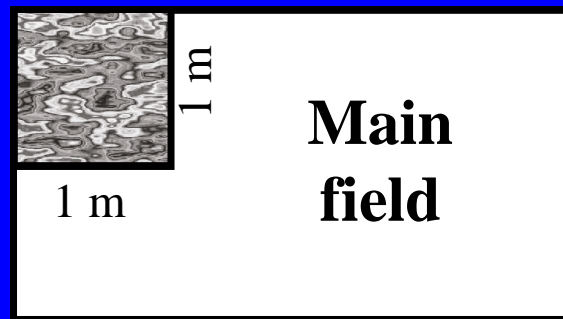


## (B) Paddy

500 g Azospirillum  
+ 500 g Phosphatika + 1-2 kg dried ground cow dung

(for 1 bigha)

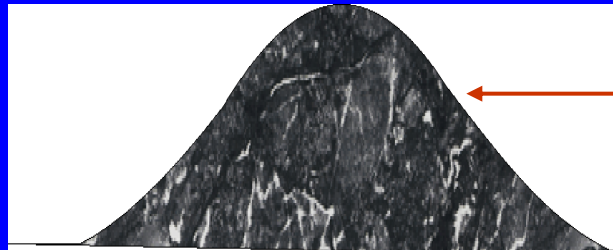
Dip the bundles of  
seedlings  
overnight  
– then transplant



### 3. Soil Treatment

4.0 Kg Azotobacter / Azospirillum + 4.0 kg Phosphatika + 200.0 kg compost. Make a heap

(For 1 acre) ↓



Cover with plastic sheet for 24-48 hours  
-then sow it and mix with soil immediately

Methods of application:

- Broadcasting
- Furrow Application (e.g.-Potato)

# Advantages of Bio-fertilizers

1. **20-50% chemical N replacement**
2. **15-25% synthetic P replacement**
3. **10-40% grain yd increase**
4. **15-30% vegetative growth**

# PEST MANAGEMENT IN ORGANIC FARMING

- 1. General Method to control bacterial and fungal diseases**
  - (a) 10% cow's urine is sprayed once in 10 days thrice.**
  - (b) Half litre cow's urine along with  $\frac{1}{2}$  litre sour buttermilk is mixed with 9 litres of water. This is sprayed once in 7 days twice.**
  - (c) Cow's urine and water is mixed in the ratio of 1:2. The seeds or the roots of seedlings are soaked in this for half an hour before sowing or transplanting.**
  - (d) 40 kg of neem cake per acre is applied as a basal manure for vegetable crops to prevent diseases.**
  - (e) If there is a disease attack in the nursery, then add 10% cow's urine extract along with the water that is used to irrigate the nursery.**

# **VEGETABLE PESTS - 1**

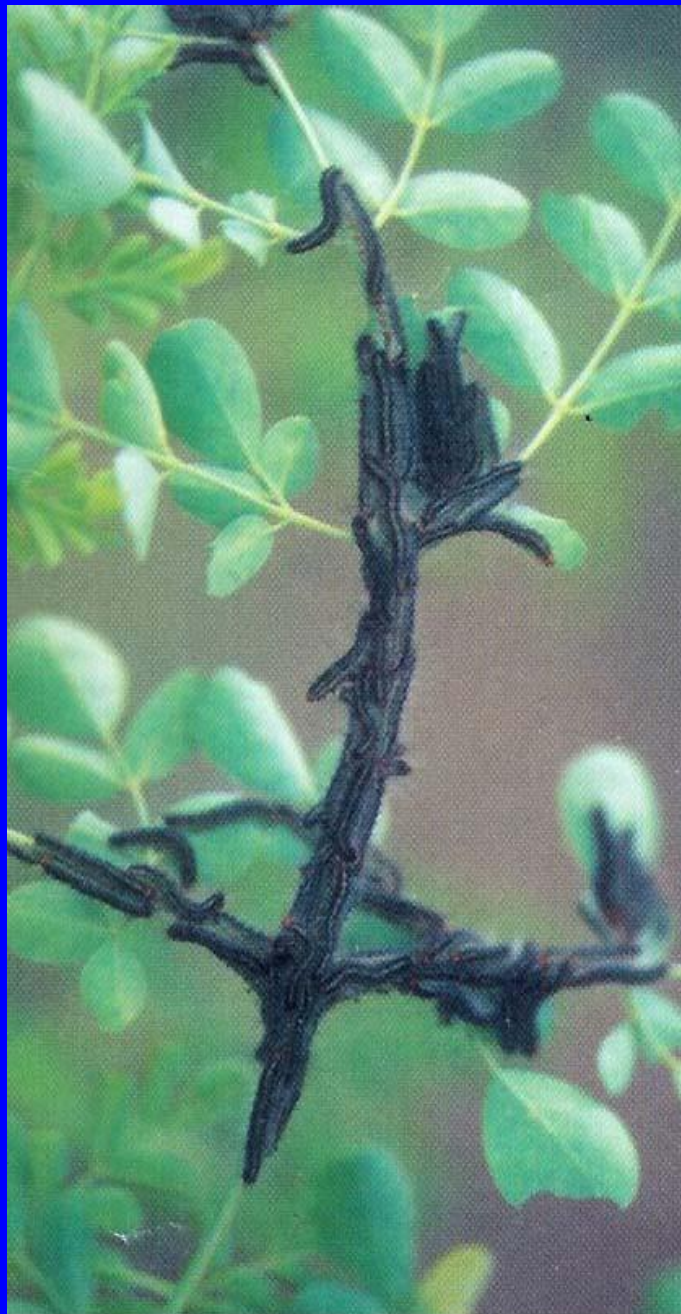


**SHOOT BORER IN BRINJAL**



**FRUIT BORER IN LADY'S FINGER**





**HAIRY CATERPILLARS IN DRUMSTICK**





**FRUIT BORER IN TOMATO**





**ARMY WORMS IN BEANS**





**STEM BORER IN RIBBED GOURD**

# **VEGETABLE PESTS - 2**





APHIDS





**MEALY BUGS**





**WHITE FLIES**





**GREEN PLANT HOPPER IN LADY'S FINGER**



# **VEGETABLE PESTS - 3**



**POD SUCKING BUG IN BEAN**



**LEAF BEETLE / PUMPKIN BEETLE**

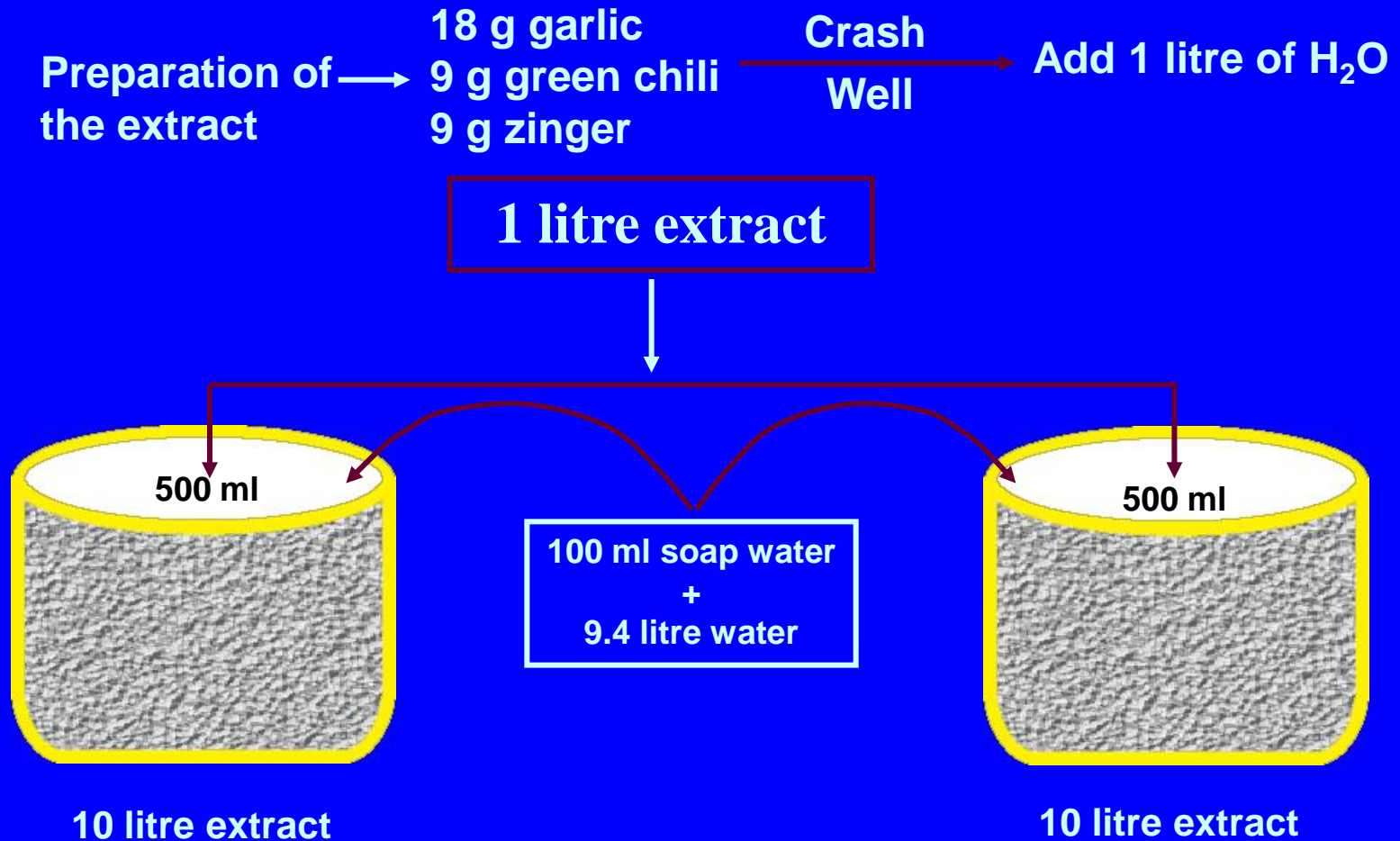




**EPILACHNA BEETLE**

## 2. Target Pests : Fruit Borer, stem borer, short borer, aphids, White flies, Mealy bugs

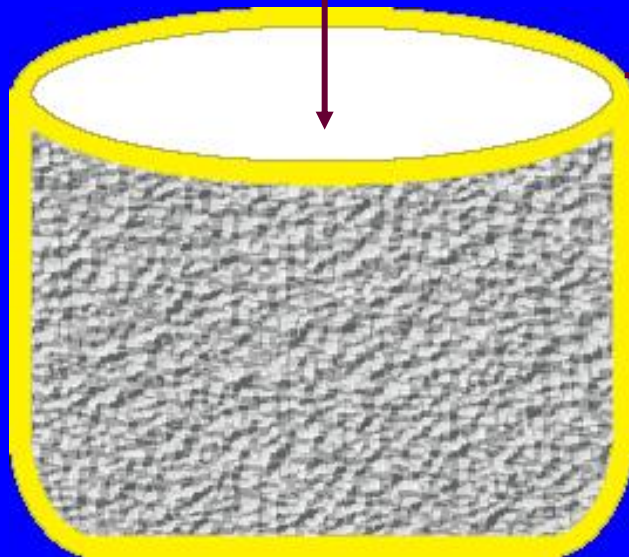
(a) Use Garlic, chilli and zinger extract



Application : Spray once within 7-10 days

**(b)**

**10 Litre cow urine + 250 g crashed  
neem cake or green hemp leaves +  
250 g ginger + 250 g tulshi leaves +  
250 green chilli**



**24 Hours  
incubation and  
then filter**

**Spray in 1:10 ratio  
(extract : water)**



### **3. Azadiractin (0.15% EC)**

**(As repellent and antifeedant)**



**At hatching egg and young stage of the pest**



**1 litre in 200-300 litre water / ha. at 15days interval**

# BIO-PESTICIDES

```
graph TD; A[BIO-PESTICIDES] --> B[Beauveria bassiana (Bb)]; B --> C[5 g / litre H2O]; C --> D[Spray]; E[Target pests– Hard scale insects]
```

**Beauveria bassiana (Bb)**

**5 g / litre H<sub>2</sub>O**

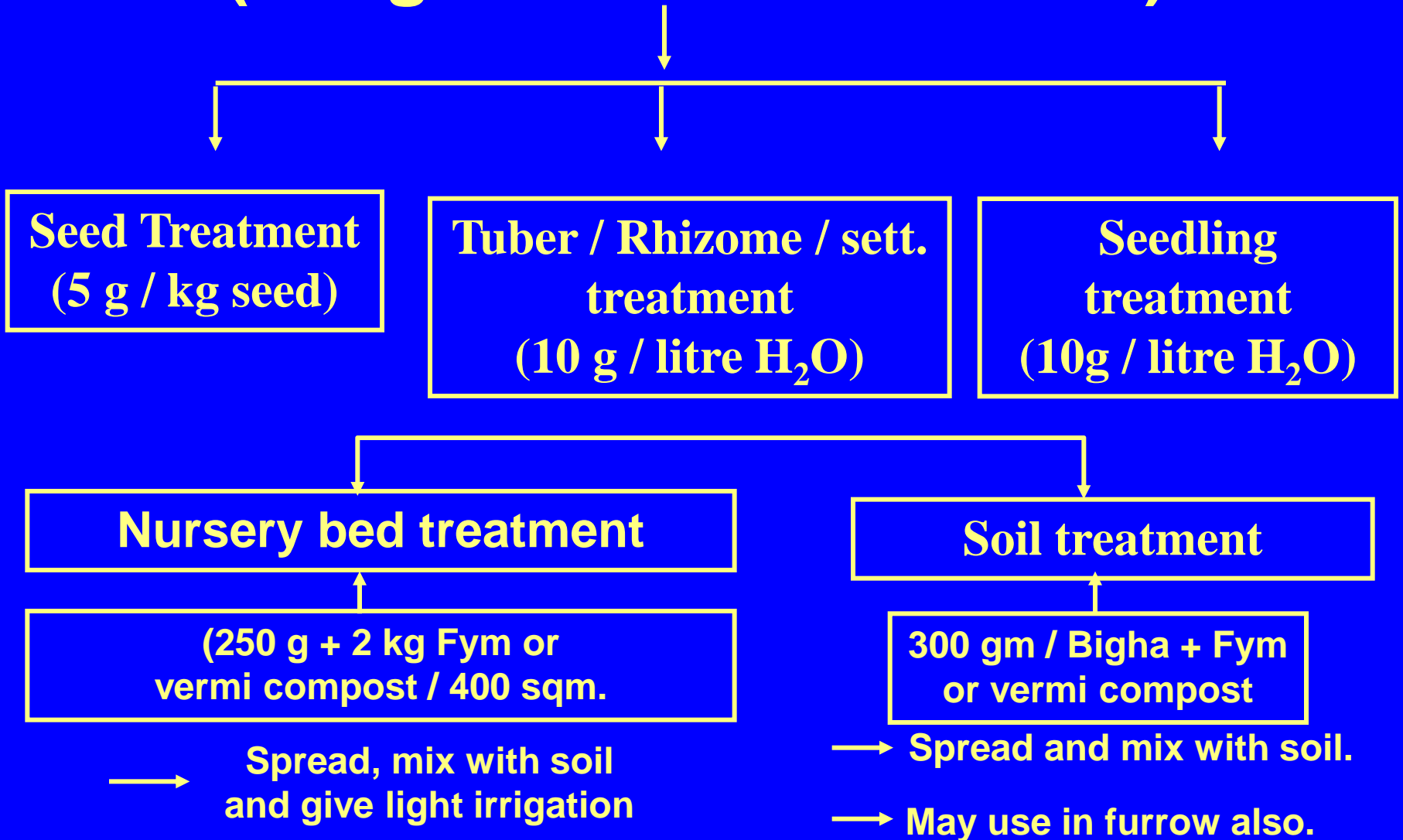
**→ Spray**

**Target pests– Hard scale insects**



# TRICHODERMA

## (Fungal disease treatment)



**To make scenario more clear all the comparisons (1230) were clubbed together on 3 parameters. The overall scenario was as follows:-**

- A. Organic with higher nutrient content and lower toxic substances —————→ 57%**
- B. Conventional with higher nutrient content and lower toxic substances —————→ 37%**
- C. No difference —————→ 07%**

### **Conclusion :**

- 1. Organically grown crops are more rich in some essential vitamins and minerals and lower in toxic components such as nitrates.**
- 2. More intensive studies are on to establish the fact.**

# NATIONAL PROJECT ON ORGANIC FARMING

```
graph TD; A[NATIONAL PROJECT ON ORGANIC FARMING] --> B[Govt. of India]; B --> C[1st October / 2004]; C --> D[Total Outlay Rs. 57.05 crores for remaining 10th 5 year plan];
```

**Govt. of  
India**

**1<sup>st</sup> October / 2004**

**Total Outlay  
Rs. 57.05  
crores for  
remaining  
10<sup>th</sup>  
5 year plan**

# MAIN OBJECTIVES

1. To facilitate, encourage and promote development of organic agriculture the country.
2. To prepare inventory of organic resources available for recycling in agriculture in different agro climatic regions.
3. To encourage production of organic sources of nutrients like bio-fertilisers, organic manuers, compost etc. and bio-pesticides, bio-control agents etc. centrified input of organic farming.
4. To act as nodal agency for formulation of standards and mechanism of accreditation, inspection, regulation, quality control and monitoring.
5. To impart training to Accreditation and Certification agencies, farmers, industries and organizations engaged in the production, promotion and marketing of different components of organic farming.
6. To provide financial support to State Govts., organisations, NGOs etc. for production and promotion of organic inputs and market development of organic produce.
7. To compile information on status of organic farming in the country, identity crops and areas and assess market for demand and supply of organic produce.

# COMPONENTS OF THE PROJECT

The components of the National Project on Organic Farming are as below :

1. **Cnstruction of building for NCOF/RCOFs**
2. **Capacity Building for promotion of organic farming through service providers.**
3. **Financial assistance for setting up of production units of**
  - **Fruit/Vegetable units**
  - **Biofertilisers units**
  - **Vermi-culture hatcheries**
4. **Training programmes for :**
  - **Certificatiion and Inspection Agencies/Services Providers.**
  - **Organic input production and quality control;**
  - **Extension officers / Field functiionaries.**
  - **Farmers training on Organic Farming**
  - **Trainers Training and International cooperation**

## **5. Field demonstrations**

- **On organic inputs including vermicompost/city compost.**
- **Setting up of model organic farms.**
- **Utilisation of enriched biogas slurry**

## **6. Market Development and promotion**

- **Development of new initiatives;**
- **Dissemination of proven technology;**
- **Creating National Awareness through International/National/Regional**

**Seminars / Exhibitions etc. and publicity through print and electronic media.**

**For Details,  
Write to**

**The Director,  
Regional Centre of Organic Farming,  
State Agricultural Farm,  
Mantripukhri, Imphal-795002**

# INDIA ORGANIC 2005 (4<sup>th</sup> Nov. to 7<sup>th</sup> Nov., 2005)

## Lal Bagh, Bangalore



**Dr. B. Kalita (2<sup>nd</sup> from right)- Showing Organic Joha Rice to a foreign visitor**



# INDIA ORGANIC 2005 (4<sup>th</sup> Nov. to 7<sup>th</sup> Nov., 2005) Lal Bagh, Bangalore



**Dr. B. Kalita (2<sup>nd</sup> from left)- discussing with Dr. Peter Pactor, a leading personality and pioneer of Biodynamic Agriculture in India**



# INDIA ORGANIC 2008, NEW DELHI





# INDIA ORGANIC 2008, NEW DELHI



**Present Global Agricultural  
Wind is blowing slowly  
towards organic**

**— Hence —**

**Go Organic**

**Think Organic**

**Eat Organic**

Thank You