

# **(a) How to Plan Good Research?**

# **(b) Global View of Research in 2030**

***Prof. (Dr.) Amar P. Garg***  
***Vice Chancellor***

***Shobhit Institute of Engineering & Technology  
(Deemed-to-be-University), MEERUT-250110***

***E-mail: vicechancellor@shobhitmeerut.ac.in***  
***amarprakashgarg@yahoo.com***  
***Mobile: 8077633273/9410608377***

***Sectional President-Environmental Science (2020-22)***  
***Indian Science Congress***



# **WHO IS A SCIENTIST OR RESEARCHER?**

- A person who is studying or has expert knowledge of one or more of the natural or physical sciences. ‘a research scientist’**
- A person who learns Science and especially natural science is a Scientific Investigator**
- A person who is trained in a science and whose job involves doing scientific research or solving scientific problems.... “A Scientist”**
- Scientist is a blind man who is searching a black cap in the dark room which is not there, and he finds some thing new which was believed not to be there ..... My opinion about a scientist**

## **Where to Begin?**

**Let's say you need some research resources for a paper you're writing for a class. You have a general topic – lactic acid bacteria – and you know you need resources, but you aren't sure how to get started.**

**Your impulse would be to start with the Internet, but instead, first consider what you need to find:**

**Quality, credible resources  
about or related to Lactic Acid  
Bacteria**

# **Narrowing What You Need**

- “**LAB**” is a **very, very broad topic, and trying to research a very, very broad topic is very, very difficult.**
- You need to narrow the topic down to something more specific – you can narrow the topic by asking yourself questions about the topic, such as...**

# **Keywords**

- Keyword searching is how you're going to conduct most of your searching.***
- Keyword searching is the combination of keywords (get it?) with operators (AND, OR, and NOT) to produce search strings***
- Remember, keywords will come from your thesis statement, but you ought to include related words and concepts as well***
- When using phrases – like Lactic acid bacteria – you need to put the phrase in quotation marks:***

Lactic Acid Bacteria, Uses, Applications, Production

# **What are scholarly resources?**

- Written by experts***
- Review Articles***
- Original Research***
- Focus on a particular field, topic, or discipline***
- Intended for others in that field or career***
- “Proper” language, technical vocabulary***
- No advertisements***
- News reports supported by original findings***
- RESEARCH ORIENTED***

*Journals are scholarly*



# **Using the Internet for Research**

- **How your *first impulse* might be to go to the Internet, but how that's not a great idea?**
- **Internet is NOT moderated or quality-controlled, and there's a lot of GARBAGE and RUMOR and outright MISINFORMATION floating around.**
- **Internet does have a LOT of GOOD information, too, BUT lot of unreliable and wrong too**

# **Using the Internet for Research**

**Sometimes it's *not so easy* to tell if a website is appropriate for research or not, because remember: *not everything is appropriate for research***

- But there are ways to tell if a website is appropriate for research or not**
- When using the Internet for research, use the following criteria to determine if a website is good for research or not – taking the time to evaluate websites will help you obtain GOOD resources**

# **Evaluating Websites for Research**

- Authority**--*who created the web page? Are they experts? What are their credentials? Do they provide contact information?*
- Accuracy**--*where did they get their information? Are the facts verifiable through another source? Do they list a bibliography of citations from where they obtained their information?*
- Objectivity**--*does the site have biases? Is the information presented in such a way to allow the viewer to make his/her own judgment, or does the site try to persuade you to adopt its viewpoint? What is the purpose of the site? \*\*\**
- Currency**--*when was the site last updated? Are the facts on the site up-to-date? Is the information current?*
- Coverage**--*how much of the topic does the resource cover? Does it attempt to cover all or most of the aspects, or is it vague?*

# ***During the Search***

- Organization is very important – keeping your resources organized means you can lay hands on what you need in an efficient way***
- Invest in some folders – pocket folders, manila folders, 3-ring binders, whatever you like!***
- Where possible, email yourself copies of the things you print off***
- Where possible, save copies of the things you print off to a jump drive or a cloud service (like Google Drive)***
- That research diary sheet we saw earlier would be appropriate at this stage***

# **After the Searching's Done...**

- You have the resources you need, either digitally or physically, if you've printed them out**
- This is when underlining and/or highlighting come into play, as well as notes and sticky notes**
- Documentation is also important, in order to avoid plagiarism – several of databases will generate citations for you**

# **After the Searching's Done...**

- Note-taking on your resources can help you focus on the important parts of the resource and exclude or ignore the stuff that's not relevant – it's filtering**
- It'll save you time, too – making note of what's useful or relevant can save you from having to read the article again and again to find the good bits**
- Note-taking can also help you begin to formulate how to express or include information from the resource in your own writing**

**STUDENT NAME** \_\_\_\_\_

### **Research note sheet**

You will take notes from your sources on this sheet, one sheet for each source. It is NOT necessary to attach printed copies of the article or website. Get the information on the article itself from the database or website, and fill in the blanks below. I should be able to locate your source from the information provided below. These sheets will also help you compile your Works Cited page and assist you with selection of research material to be documented in the text. I strongly encourage you to create a personal [REDACTED] folder to keep your database articles in, and bookmark the websites.

Author \_\_\_\_\_

Title of the work (quotation marks) \_\_\_\_\_

Name of Journal (Italicized) \_\_\_\_\_

Volume, Issue number \_\_\_\_\_

(Date of publication) \_\_\_\_\_

Pages \_\_\_\_\_

Name of database (italics) \_\_\_\_\_

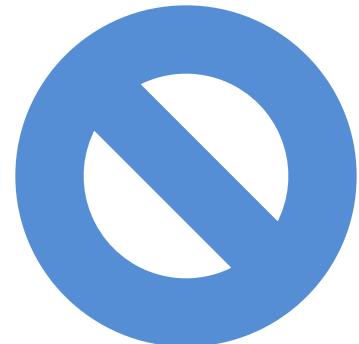
Date of Access \_\_\_\_\_

Usable statistics	Usable quotes	Paraphrases

This research diary could be easily  
adapted and used for books and websites  
as well – any resource you end up using for  
your research!

# **RECAP**

- DO create a list of keywords***
  - DO underline/highlight/bookmark***
  - DO take notes/sticky notes***
  - DO get organized***
- 
- DON'T multi-task***
  - DON'T plagiarize***



# **WHO IS A “LEGAL RESEARCHER?”**

**A legal researcher is often a paralegal or legal assistant who examines legal history and precedent, often to provide pertinent background information on a case to a lawyer or law firm.**

**A legal researcher is an individual who undertakes in-depth research into any aspects of the law in support of a company or individual.**

**A legal researcher is one who is basically responsible for researching cases and anything that can help to win a case**

## **WHAT IS LEGAL RESEARCH?**

**Legal research is "the process of identifying and retrieving information necessary to support legal decision-making. In its broadest sense, legal research includes each step of a course of action that begins with an analysis of the facts of a problem and concludes with the application and communication of the results of the investigation. (Jacobstein & Mersky)**

**Legal Research is the process of locating an answer to an unknown legal problem, verifying the law, and reading cases or statutes.**

# **How Legal Research Differs from Research in Other Contexts**

- **You need to be:**
  - **Aware of legal materials;**
  - **Familiar with multiple sources and different techniques for each researching various types of problems;**
  - **Able to search for primary authorities, as well as a large range of secondary and tertiary sources; and,**
  - **Make sure that your research is correct, informative and up-to-date.**

# **Some Aspects of Legal Research**

- ***Identifying the problem (who is the owner?)***
- ***Gathering of facts (the name/postcodes)***
- ***Analysing those facts (what can we tell from them / how best to use them?)***
- ***Identifying research sources (internet)***
- ***Finding search terms (name / postcodes)***
- ***Locating relevant sources (BT / Multi-map)***
- ***Using the sources effectively (narrowing the search)***
- ***Applying the findings to the problem (finding the relatives and then the owner)***

# ***Why is Legal Research Important?***

## ***LEGAL RESEARCH IS A VITAL SKILL IN PRACTICE***

- ***Legal problem solving***
- ***Practical problem solving***

### ***IMPORTANCE:***

1. ***Research is the lawyer's key skill***
2. ***Effective research takes in every aspect and every stage of the case***
3. ***Not every problem is necessarily a legal problem which need research***

# **The Problem of Legal Research**

...

- ***Thousands of newly decided cases***
- ***Identification of problem areas for research***
- ***Key words / phrases***
- ***Research Report***
- ***Additional information, if required***
- ***Summary***

# **Sources of Legal Research Materials**

- **Primary Authority**

- *information in its original form*

**Judicial and Administrative decisions, Enacted Legislation, Judicial Pronouncements, Thesis, Official Documents, Views & Interviews; views of Jurists etc.**

- **Secondary Authority-** *Sources of information that describe or interpret the law, such as legal treatises, law review articles, scholarly legal writings, citations of lawyers used to persuade a court to reach a particular decision in a case, but which the court is not obligated to follow, Dictionary, writings, Books, Compilations, articles; an interpretation of case law and/or Legislation, Reports, Government documents etc. are the examples*

- **Tertiary Authority**

- *Directories (jurists, journals and Archives) Library catalogue, periodical indexes, search engines, legal gateways/portals, case digests etc.*

# **Paper vs. Electronic Research**

- ***Advantages & Disadvantages***
- ***Both necessary in present day legal and practical research***
- ***Why you'll need both***
- ***When to use each method***

# **Types of Legal Research**

- **Research done by a legal scholar**
  - **Usually directed toward general conclusions**
  - **Broad/exhaustive searches**
  - **Attempt to find and discuss all relevant material**
  - **End result: a critical piece of work**
- **Research done by a lawyer**
  - **Attempt to find and apply legal authority relevant to the precise question of client**
  - **More narrowly focused**
  - **Deadline-driven**
  - **End result: a specific legal document, e.g. memorandum of law**

**REMEMBER**

**MAKE SURE THAT YOUR**

**RESEARCH IS:**

**THOROUGH**

**RELEVANT**

**ACCURATE**

**UP-TO-DATE**

**PROPERLY REFERENCED**

**PROPERLY WRITTEN**

# ***The Four C's of Good Research:***



***orrect***  
***omprehensive***  
***redible***  
***ost-effective***

***RESEARCH in 2030***

# ***Advancement in COMPUTER TECHNOLOGY***

***Machine learning,  
Robotics,  
Artificial Intelligence,  
Bio, Chemi, Electronic -sensors,  
Genome sequencing***

***Proteomics***

***Medical system to advance more in  
next decade than in last 100 years***

# ***Self-serve Diagnostic kits:***

***Computer based medical technology with the help of Artificial Intelligence and machine learning will facilitate the development of self serve diagnostic kits and star trek style portable systems.***

***Robots will replace nursing staff and will do the surgery.***

***Tele-surgery will allow the world's top surgeons to do their work from their comfort hospital.***

***Cell and organ culture will facilitate the replacement of ailing organs.***

***CRISPR babies transplanted genetically caused blindness Technology-Designer (recently to remove CAS-9***

***Artificial meet- Researches ib CCMB, Hyderabad***

# ***Customized Medicines***

***Gene Kundali-Genome will be sequenced and diseases predicted***

***Genetic computer based technology will facilitate the production of medicines as per the needs of personal genome.***

# ***PROBIOTICS & BACTERIA as Medicines:***

***Probiotics and functional foods will treat the major diseases including most cancers.***

***Treatment of various diseases with microbial cultures will be the major medical practice.***

# **HUMAN MICROBIOME**

***Human is not the product of its own genes but the researchers have now proved that our body contains 10 times more microbes (40 trillion) than cells.***

***Microbiome may be a missing link between environment, genome and human health.***

# **DIETARY HABITS:-**

**Dietary habits will change in next decade (post COVID-19 effect).**

**Non-veg. population will decline.**

**Vegetarians will be more inclined to plant based diets, fruits, butter and milk diets**

**Chinese will lose interest in pork and raw wild animals meat.**

**Dietary habits will reshape global economy and the trade will flow to agriculture forcing the companies to develop new food products to serve shifting tastes.**

***Organic agriculture including aquaculture will flourish.***

***Biotechnology will facilitate the production of genetically modified crops to meet the growing demand of qualitative nutritious food.***

***Plant breeders will produce early maturing high yielding hybrid varieties which will govern the economy of a country.***

**Environmentally controlled  
cropping will facilitate the  
production of all types of  
food crops in all areas round  
the year.**

**Terrace Gardening**  
**Vertical Farming** **will**  
**increase**  
**Drought resistant varieties**

***Bigger herds and fatter animals will be the future trend.***

***Wild animals population will decrease***

***More emphasis on preservation of Biodiversity***

***Advances in engineering and technology will make the products within the reach of last person.***

***Food Chain System will develop***

***Preserved Food, Use of Bio-preservatives will increase***

***Processed Food availability***

**Geo-engineering, smart grids including solar power, nanotechnology, green engineering, sustainable cities, deeper knowledge of space, climate change, communication technology and production of drinking water from oceans will change the life of a common man. The nations which will develop new innovative cheaper technologies will govern the economy of the world in next decade.**

# Bio-weapons Research

Disease	Transmit Human to Human	Infective Dose (Aerosol)	Incubation Period	Duration of illness	Lethality (approx. case fatality rates)	Persistence of Organism	Vaccine Efficacy (aerosol exposure)
<b>Anthrax</b>	No	8,000 - 50,000 spores	1-6 days	3-5 days (usually fatal if untreated)	High	Very stable - spores remain viable for > 40 years in soil > 100 days in human beings	As recommended and approved by National Regulatory Authority
<b>Brucellosis</b>	No	10-100 organisms	5-60 days (usually 1-2 months)	Weeks to months	<5% untreated	Very stable	No vaccine
<b>Cholera</b>	Rare	10-500 organisms	4 hours - 5 days (usually 2-3 days)	≥ 1 week	Low with treatment, high without	Unstable in aerosols & fresh water; stable in salt water	No data on aerosol
<b>Glanders</b>	Low	Assumed low	10-14 days via aerosol	Death in 7-10 days in septicemic form	> 50%	Very stable	No vaccine
<b>Melioidosis</b>	Low	Assumed low	1-21 days (up to years)	Death in 2-3 days with septicemic form (untreated)	19-50% for severe disease	Very stable; survives indefinitely in warm moist soil or stagnant water	No vaccine
<b>Plague</b>	Moderate, Pneumonic	100-500 organisms	1-7 days (usually 2-3 days)	1-6 days (usually fatal)	High unless treated within 12-24 hours	For up to 1 year in soil; 270 days in live tissue	3 doses not protective against 118 LD <sub>50</sub> in monkeys

Disease	Transmit Human to Human	Infective Dose (Aerosol)	Incubation Period	Duration of illness	Lethality (approx. case fatality rates)	Persistence of Organism	Vaccine Efficacy (aerosol exposure)
<b>Tularemia</b>	No	10-50 organisms	1-21 days (average 3-6)	≥ 2 weeks	Moderate if untreated	For months in moist soil or other media	80% protection against 1-10 LD <sub>50</sub>
<b>Smallpox</b>	High	Assumed low (10-100) organisms)	7-17 days (average 12)	4 weeks	High to moderate	Very stable	Vaccine protects against large doses in primates
<b>Venezuelan Equine Encephalitis</b>	Low	10-100 organisms	2-6 days	Days to weeks	Low	Relatively unstable	TC 83 protects against 30-500 LD <sub>50</sub> in hamsters
<b>Viral Hemorrhagic Fevers</b>	Moderate	1-10 organisms	4-21 days	Death between 7-16 days	High to moderate depends on agent	Relatively unstable - depends on agent	No vaccine
<b>Botulism</b>	No	0.001 µg/kg is LD <sub>50</sub> for type A	12 hours -5 days	Death in 24-72 hours; lasts months if not lethal	High without respiratory support	For weeks in nonmoving water and food	3 dose efficacy 100% against 25-250 LD <sub>50</sub> in primates
<b>Staph Enterotoxin B</b>	No	0.03 µg/person incapacitation	3-12 hours after inhalation	Hours	< 1%	Resistant to freezing	No vaccine
<b>Ricin</b>	No	3-5 µg/kg is LD <sub>50</sub> in mice	18-24 hours	Days - death within 10-12 days for ingestion	High	Stable	No vaccine
<b>T-2 Mycotoxins</b>	No	Moderate	2-4 hours	Days to months	Moderate	For years at room temperature	No vaccine

## **Types of Bio-weapons:**

**Category A: includes Anthrax (*Bacillus anthracis*), Botulism (*Clostridium botulinum toxin*), tularemia (*Francisciella tularensis*), small pox (*Variola major*), plague (*Yersinia pestis*) and viral hemorrhagic fever (*Arenaviruses, Bunyaviridae, Filoviridae*)**

**These are easily disseminated and transmitted from person to person, cause high mortality, public panic and require special action for public health**

## CATEGORY A (contd.)

- ***Easily disseminated or transmitted person-to-person cause high mortality***
- ***Require special action for public health preparedness***

### ***Toxins: Clostridium botulinum toxin (botulism)***



## **Category B includes**

**Q fever (*Coxiella burnetii*), Glanders (*Burkholderia mallei*), Brucellosis (*Brucella spp.*), Alpha viruses (Venezuelan encephalomyelitis, Eastern equine encephalomyelitis, Western equine encephalomyelitis) and Toxins (from *Ricinus communis*, *Clostridium perfringens*,**

***Staphylococcus aureus*), food and water borne pathogens (mainly *Salmonella spp.*, *Shigella dysenteriae*, *Escherichia coli* 0157:H7, *Vibrio cholera* and *Cryptosporidium parvum*) that are moderately easy to disseminate, cause moderate morbidity and low mortality require enhanced disease surveillance.**

# **Category B (contd.)**

- **Viruses: Alpha viruses**

- **Bacteria: Coxiella burnetii (Q fever),  
*Brucella* spp. (brucellosis),  
*Burkholderia mallei* (glanders), *Clostridium perfringens episilon toxin*, *Staphylococcus enterotoxin B***



- **Food/waterborne pathogens: *Salmonella* spp.,  
*Vibrio cholerae*, *Shigella dysenteriae*,  
*Cryptosporidium parvum*, etc.**

- **Moderately easy to disseminate**
- **Moderate morbidity and low mortality**
- **Require improved diagnostic capacity & enhanced surveillance**

**CATEGORY C** includes emerging populations to which general public lack immunity and has potential for genetic manipulation for mass dissemination in future because of high morbidity and mortality and major public health impact.

Examples are potential strains of avian influenza, Nipah, Hantavirus, SARS, Ebola, tick borne hemorrhagic and encephalitis viruses, yellow fever and others.

•**Bacteria:** Multi-drug resistant *Mycobacterium tuberculosis (MDR)*

Society has limited ability to prevent bioterrorist attacks.

# **Economics of Bio-weapons**

- **Bio-weapons – commonly called ‘the poor man’s nuclear bomb’**
- **Large scale operation may cost as much as \$ 2,000 per sq. km with conventional weapons,**
- **\$ 800 with nuclear weapons,**
- **\$ 600 with nerve gas weapons and**
- **\$ 1 with biological weapons**
- **Establishment cost-simple just a fermentor or even simple laboratory flask, small room**
- **Training cost- simple, one can be trained in 2 weeks**

# **AGRICULTURAL VIEW OF INDIA**

- **India has achieved record food grain production of 275.11 million tonnes during 2016-17 and 300 million tonnes of fruits & vegetables largely due to favourable monsoon after two consecutive years of deficit rainfall.**
- **48% of the population of India dependent on agriculture.**
- **Crops including fruits and vegetables account for 59.0 % of GDP in “agriculture, forestry and fishing” sector. Around 41.0 % of GVA of this sector based on livestock products, forestry and fisheries.**

# GDP contribution

Period	1960-61/ 1968-69	1968-69/ 1975-76	1975-76/ 1988-89	1988-89/ 1995-96	1995-96/ 2004-05	2004-05/ 2014-15
<b>Average GDP @2004-05 prices (Rs Billion)</b>						
Agriculture	1636	1955	2547	3473	4358	5771
<b>Agriculture &amp; Allied Activities</b>	<b>2004</b>	<b>2401</b>	<b>3047</b>	<b>4116</b>	<b>5174</b>	<b>6911</b>
Industry	725	1000	1676	2958	4773	9470
Services	1859	2517	4078	7286	13083	28991
<b>Share of (%)</b>						
Agriculture	35.7	33.0	28.9	24.2	18.9	12.7
<b>Agriculture &amp; Allied Activities</b>	<b>43.7</b>	<b>40.6</b>	<b>34.6</b>	<b>28.7</b>	<b>22.5</b>	<b>15.2</b>
Industry	15.8	16.9	19.0	20.6	20.7	20.9
Services	40.5	42.5	46.3	50.7	56.8	63.9

**Agro-processing (textiles, food, oil, etc.), retail, credit, warehousing, transport, etc. are also GDP contributors that rely on agriculture for their growth.**

# **Production Status of Crops**

(as on 27.02.2018)

Name of the Crops	2015-16	2016-17	2017-18
Rice	104.41	109.70	111.01
Wheat	92.29	98.51	97.11
Jowar	4.24	4.57	4.66
Bajra	8.07	9.73	9.26
Maize	22.57	25.90	27.14
Ragi	1.82	1.39	1.96
Small Millets	0.39	0.44	0.42
Barley	1.44	1.75	1.99
Coarse Cereals	38.52	43.77	45.42
Cereals	235.22	251.98	253.54
Tur	2.56	4.87	4.02
Gram	7.06	9.38	11.10
Urad	1.95	2.83	3.23
Moong	1.59	2.17	1.74
Other Kharif Pulses	0.72	0.89	0.79
Other Rabi Pulses	2.47	2.99	3.07
Total Pulses	16.35	23.13	23.95
<b>Total Foodgrains</b>	<b>251.57</b>	<b>275.11</b>	<b>277.49</b>

# ***Not just food grains***

Major produce type	Quantity
Milk	165 mill tons
Eggs	83,929 mill pcs
Fish	10.79 mill tons
Meats including Poultry	7.02 mill tons
Fibre crops	7.52 mill tons
Cereals	252.73 mill tons
Pulses	22.95 mill tons
Oilseeds	32.1 mill tons
Sugar cane	306.72 mill tons
Horticulture	300.64 mill tons

***In addition to this output from agro-forestry, tea, coffee, tobacco, wool, leather, bamboo, etc. More than 1.1 billion tons of output from agricultural sectors.***

# **Sources to Improve Farmers Income**

**DFI Committee identified Seven Sources of Income Growth:**

- I. Improvement in crop productivity**
- II. Improvement in livestock productivity**
- III. Resource use efficiency or savings in cost of production**
- IV. Increase in cropping intensity**
- V. Diversification towards high value crops**
- VI. Improvement in real prices received by farmers**
- VII. Shift from farm to non-farm occupations**

# ***Biofertilizers and Biopesticides in Indian Agriculture***

# **Major Causes of Declining Crop Productivity in India**

- **Imbalanced and indiscriminate use of chemical fertilizers**
- **Occurrence of multi-nutrients deficiency like-zinc, boron, sulphur etc. besides NPK**
- **Rain dependent agriculture - about 2/3 area**
- **Inadequate irrigation facilities**
- **Continuous fragmentation of land, unfavourable for adoption of technology**
- **Land holding pattern and Predominance of marginal and small farmers**
- **Lesser knowledge of modern agricultural technology to majority of farmers**
- **Inadequate support by the Government**

# **SERIOUS EFFECTS OF CHEMICAL FERTILIZERS**

- **Growth in agricultural production during the last three decades has been accompanied by a sharp increase in the use of chemical fertilizers, causing serious damage to soil fertility.**
- **Deleterious effect of excessive chemical fertilizers (especially nitrogenous) on the quality of soil and ground water.**
- **These are expensive**
- **Health hazards**
- **Disturbance of Ecosystem**
- **Pollution**

# **WHAT ARE BIOFERTILIZERS?**

- **Large populations of a specific or a group of beneficial microbes that enhance soil fertility and the crop productivity**
- **Preparation containing live microbes which helps in enhancing the soil fertility either by fixing atmospheric nitrogen, solubilization of phosphorus or decomposition of organic wastes or by augmenting plant growth by producing growth hormones with their biological activities.**

# ***TYPES OF BIOFERTILIZERS***

**1. Nitrogen fixing** –fix atmospheric nitrogen in readily useable forms by plants. These include **Rhizobium, Azotobacter, Azospirillum, blue green algae (BGA) and Azolla**. **Rhizobium** requires symbiotic association with the root nodules of legumes to fix nitrogen while others can fix nitrogen independently.

**2. Phosphate solubilizing-** (PSM) secrete organic acids which enhance the uptake of phosphorus by plants by dissolving rock phosphate and tri-calcium phosphates. PSMs are particularly valuable as they are not crop specific and can benefit all crops

**3. Compost Enhancer** – Lignocarbohydrate degrading microbes (mainly actinomycetes, bacteria, fungi and others)

# **COMPOST**

**Vermi Compost- Eco-friendly, rich in nitrogen, phosphorus, potassium, organic carbon, Sulphur, hormones, vitamins, enzymes and antibiotics that improve the quality and quantity of yield**

**Bio-compost-sugar industry waste degraded by microbes, rich in nitrogen, phosphate solubilizing bacteria and useful fungi, increase soil fertility , results in good quality products.**

**Bokashi- (Japanese-fermented organic matter)**  
**Made with molasses, water, wheat bran and beneficial microbes; also includes manures, spent mushroom compost, forest soil, tea, yeasts, wine and beer**

# **Major Microbial Products**

- **Phospho:** release insoluble phosphorus in soil and fix it which is of great significance
- **Rhizo-** induces nitrogen fixation in nodules of legumes
- **Azoto-** fixes atmospheric nitrogen and also protects roots from other pathogens
- **Tricho-non-pathogenic, eco-friendly, antagonistic, hyper-parasitic against different pathogens, bio-control agent**

# Sugarcane with application of biofertilizer and biopesticides



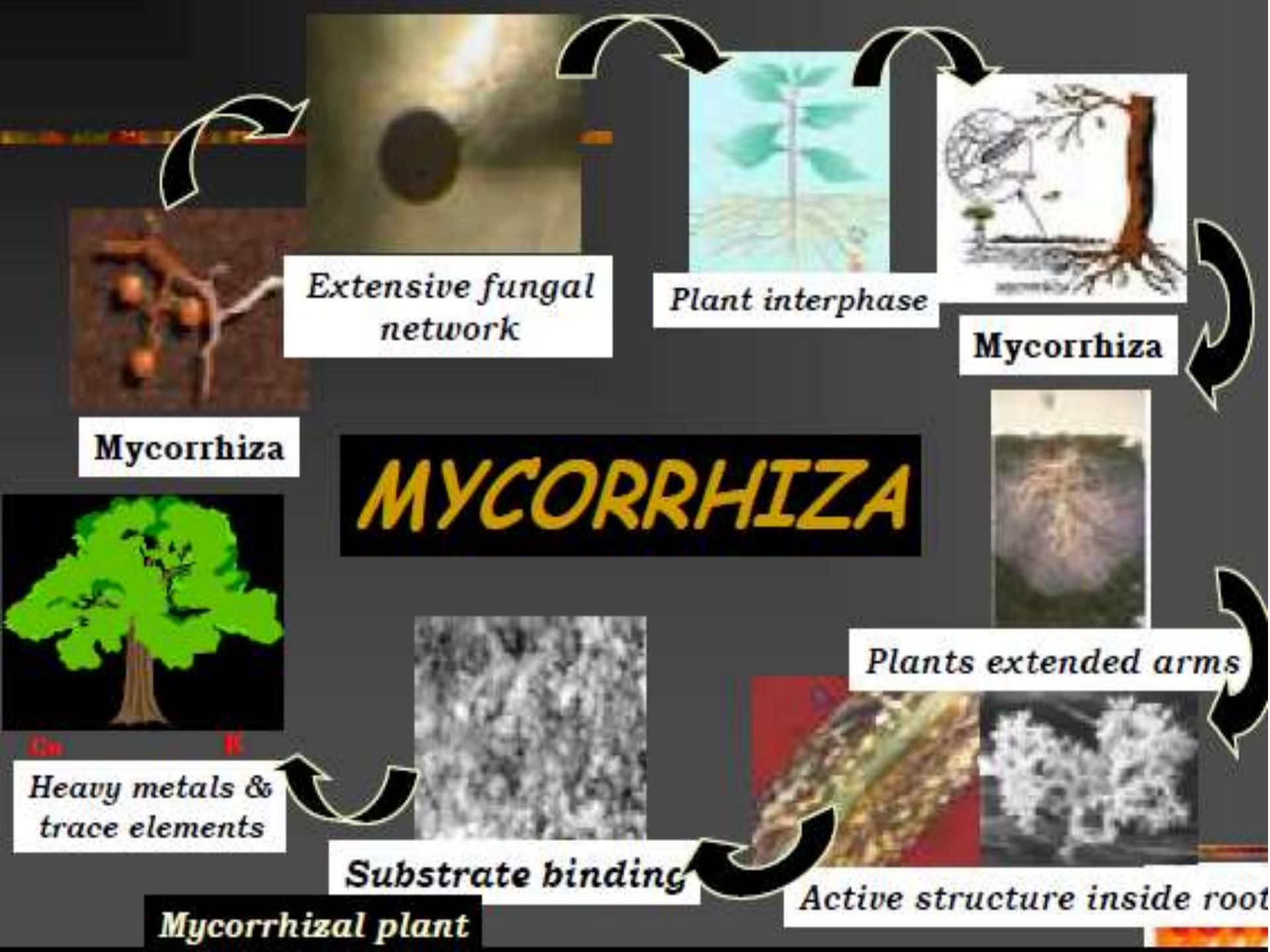
IPM



Chemical



Control



# Use of Bio-fertilizers in Indian agriculture

- ***The green revolution brought impressive gains in food production but with insufficient concern for sustainability.***
- ***In India the availability and affordability of fossil fuel based chemical fertilizers at the farm level have been ensured only through imports and subsidies.***
- ***Dependence on chemical fertilizers for future agricultural growth would mean further loss in soil quality and possibilities of water contamination.***
- ***The Government of India has been trying to promote an improved practice involving use of bio-fertilizers along with chemical fertilizers.***
- ***The role of bio-fertilizers assumes special significance due to increased cost of chemical fertilizers and their ill effects on soil health***

# **Production of Bio-fertilizers in India**

- ***The idea of using micro-organisms to improve land productivity has been around in India for at least 70 years, but it was only in the 1990s that large scale production of various biofertilizers commenced.***
- ***Presently, a number of agricultural Universities, State Agricultural Departments and thousands of Commercial enterprises produce various biofertilizers.***
- ***Farmers also produce a large variety of compost and biofertilizers***

# **Objectives of Producing Bio-fertilizers in India**

- **Promotion of biofertilizers mainly by the National Bio-fertilizer Development Centre (Ghaziabad), which was set up in 1987.**

## **Major objectives of the National Centre are to:**

- **Produce and market bio-fertilizers of required quality;**
- **Isolate and maintain bio-fertilizer strains suitable to various agro-climatic regions;**
- **Train agricultural extension workers;**
- **Promote bio-fertilizers through field demonstrations;**
- **Prepare quality parameters;**
- **To test samples of bio-fertilizers produced by others;**
- **Provide technical and financial assistance to units producing bio-fertilizers.**

# **Issues of Sustainability and Role of Bio-fertilizers**

## **Land Holding Pattern And Sustainability**

**80 % of Indian Farmers are Small and Marginal with operational holding of less than 1.4 hectares**

**Wheat and Rice are the two Major crops grown in India**

- Average yield for Wheat is 2617 Kg / Hectare**
- Average yield for Rice is 2101 Kg / Hectare**

# **Factors For Sustainability**

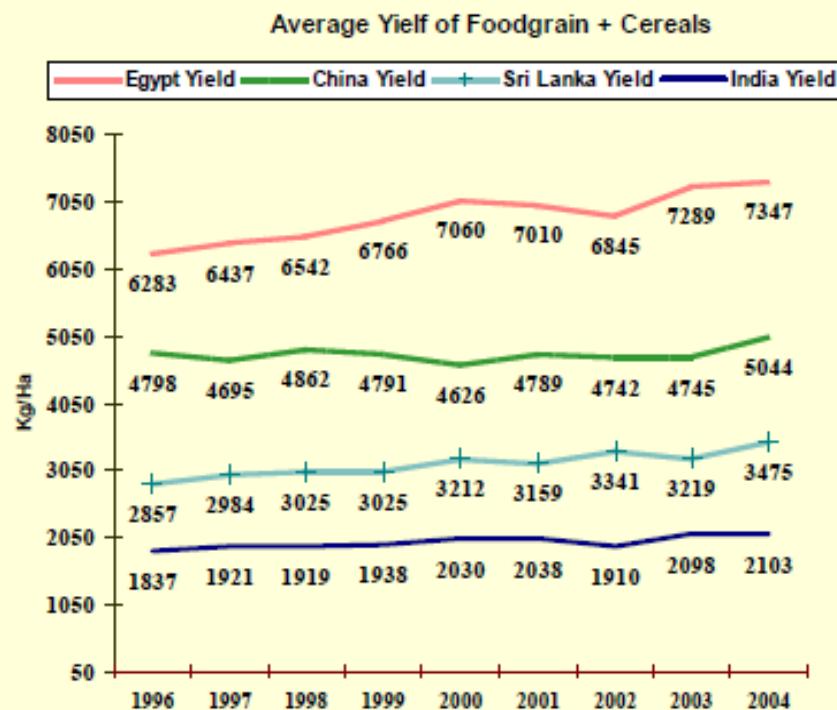
## **Raise Farm Income**

- **Increase crop productivity through balanced use of Fertilizers**
- **Managing Cost of Inputs Increase fertilizer use efficiency**
- **Generation of Additional Income to Farmers through allied activities**
- **Technical knowledge to farmers**
- **Awareness for use of bio-fertilizers**
- **Promotion of organic farming**
- **Minimal support price of agricultural produce (perishable and cash crops)**

# Comparison to Other Countries

	Country	Fertiliser Uses Kg/Ha
1	India	104.7
2	Pakistan	164.1
3	Bangladesh	188.6
4	France	215.9
5	Sri Lanka	271.8
6	China	275.1
7	United Kingdom	315.1
8	Egypt	471.5
9	N. Zealand	668.5

Due to higher level of consumption, productivity is on rise in Egypt, China, Srilanka



Country	2003 Kg/ha	2004 Kg/ha	Increase in Yield Kg/ha
Egypt	7209	7347	138
China	4745	5044	299
Srilanka	3219	3475	256
India	2098	2103	5

# **Farmers' Perspectives in Using Bio-fertilizer in Agriculture in India**

## **Problems of Farmers**

### **Availability**

- **Many farmers have stopped using bio-fertilizers partly because of the unreliable supply. It is largely because biofertilizers are not being sold by most shops.**

### **Quality**

- **Poor quality and performance of bio-fertilizers is a serious problems.**
- **Most studies suggest that the bio-fertilizers being sold in the market are contaminated and have a low count of micro-organisms. It is therefore not surprising that the performance is poor and uneven.**
- **Lesser shelf life**

# **Why Poor performance of Bio-fertilizers in India?**

- **Primarily because of inappropriate strains and inefficient production technology.**
- **Agro-climatic conditions and soil characteristics vary**
- **Large range of strains of each bio-fertilizer needs to be isolated for each area.**
- **Until strains which can tolerate wide variations in temperature can be identified, the performance of bio-fertilizers in India will continue to remain poor.**
- **Production of bio-fertilizers is prone to contamination, which reduces the effectiveness of micro-organisms. It is, therefore, vitally important that throughout the process aseptic conditions are required.**
- **Most important problem is that Indian producers do not sterilize the carriers used for mixing the bacterial solution which results in contamination**

# **Some Commercial Bio-fertilizers in Indian Market**



# **The Potential for Bio-pesticides**

- **About 100,000 tons of pesticides are used in agriculture in India annually**
- **The intensive use of pesticides in agriculture is a cause of serious concern.**
- **The problem is especially serious because of the development of resistance to pesticides in important pests and the presence of pesticide residue in food chain (agricultural + dairy products).**
- **Growing pesticide resistance has meant that a large proportion of agricultural production is lost to pests.**
- **Hence, alternative, environment friendly methods of plant protection are required, such as integrated pest management (IPM) including the use of bio-pesticides.**

# **Advantages of using Bio-pesticides and Bio-control Agents**

- **Bio-pesticides are derived from animals, plants and microorganisms such as bacteria, fungi and viruses.**
- **They are inherently less harmful than chemical pesticides**
- **They are more target specific than chemical pesticides affecting only the target pests and their close relatives.**
- **In contrast, chemical pesticides often destroy friendly insects, birds and mammals.**
- **They are often effective in small quantities. Also, they decompose quickly and do not leave problematic residues.**

# **Some Important Bio-pesticides and Bio-control Agents**

## *Bacillus thuringiensis (Bt).*

- ***Bacillus thuringiensis is the most commonly used bio-pesticide globally.***
- ***It is primarily a pathogen of lepidopterous pests of which some are most damaging.***
- ***When ingested by pest larvae, Bt releases toxins which damage the mid gut of the pest, eventually killing it.***
- ***Bt based pesticides are being marketed by three companies in India. The total sale in 2017 was about 110 tons.***
- ***Not very encouraging***



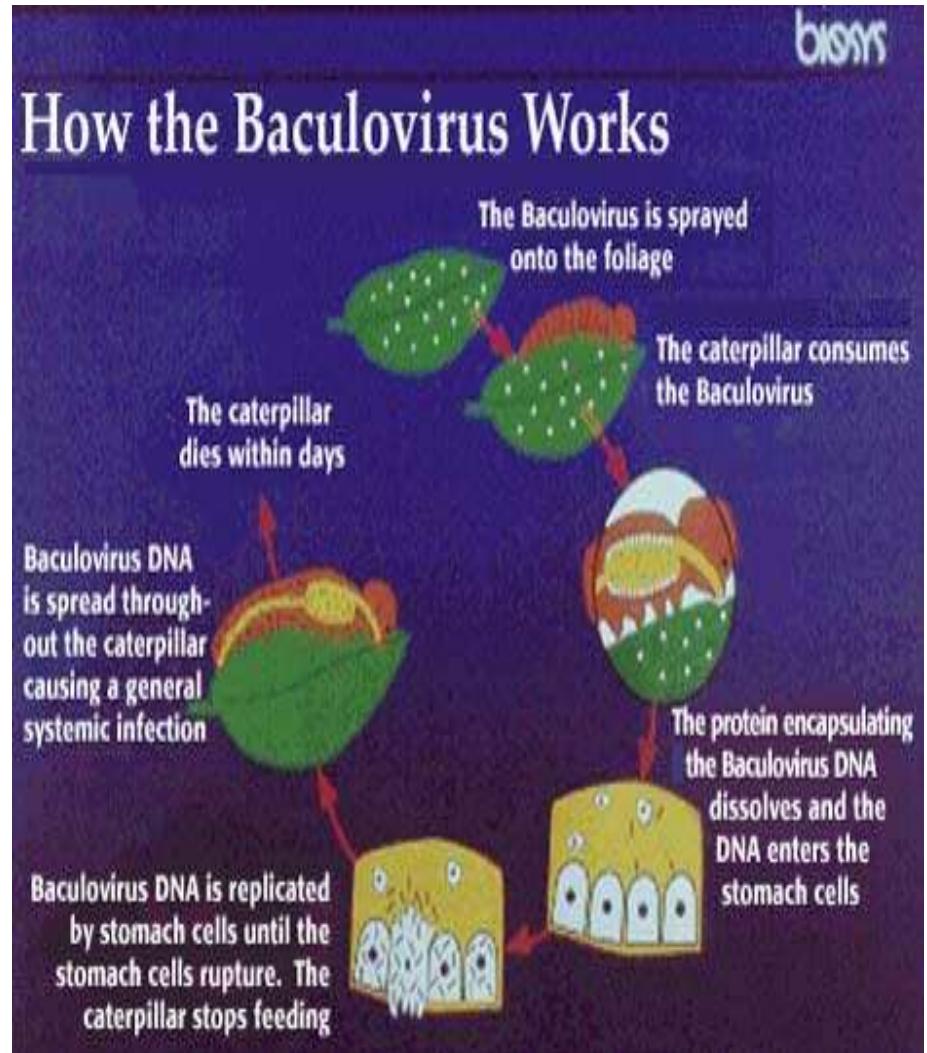
# Baculoviruses

**These are target specific viruses which can infect and destroy a number of important plant pests.**

**They are particularly effective against the lepidopterous pests of cotton, rice and vegetables.**

**Their large-scale production poses certain difficulties, so their use has been limited to small areas.**

**They are not available commercially in India, but are being produced on a small scale by various IPM centres and state agricultural departments.**



# **Trichogramma.**

**Trichogramma are minute wasps which are exclusively egg-parasites.**

**They lay eggs in the eggs of various lepidopteran pests. After hatching, the Trichogramma larvae feed on and destroy the host egg.**

**Trichogramma is particularly effective against lepidopteran pests like the sugarcane internode borer, pink bollworm and sooted bollworms in cotton and stem borers in rice. They are also used against vegetable and fruit pests.**

**Trichogramma is the most popular bio-control agent in India, mainly because it kills the pest in the egg stage, ensuring that the parasite is destroyed before any damage is done to the crop.**

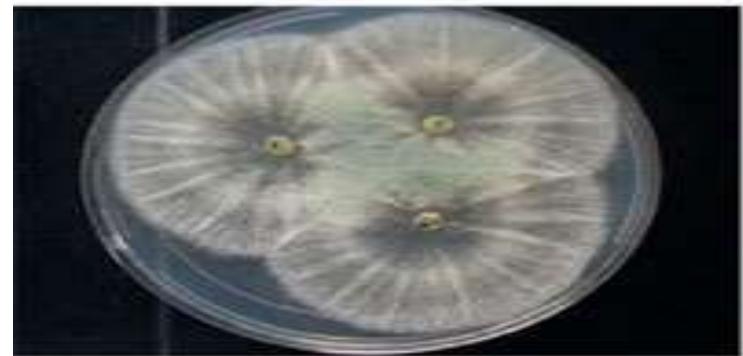
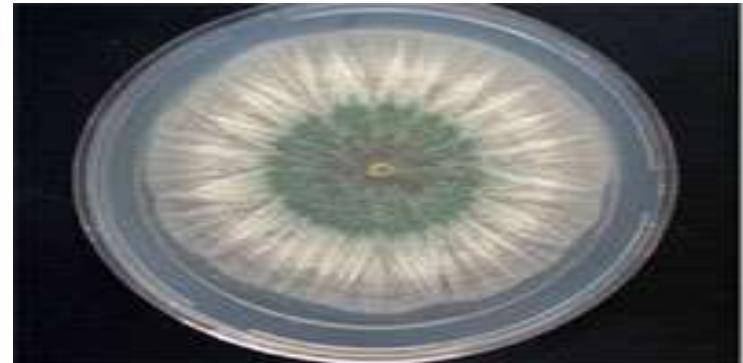


# ***Trichoderma***

***Trichoderma is a fungicide effective against soil born pathogens/diseases such as root rot.***

***It is particularly relevant for dry land crops such as groundnut, black gram, green gram and chickpea, which are susceptible to these diseases.***

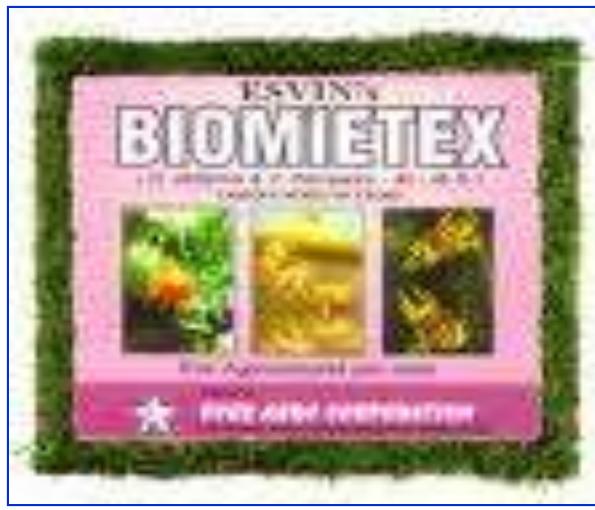
***Several companies are marketing Trichoderma in India.***



# ***Some Important Plants used for Biopesticides in India***

Name of tree	Part extract or of the tree	Chemical(s) extract	Final product
East Indian walnut ( <i>Albizia lebbeck</i> )	Seeds, leaves, bark, and roots	Caffeic acid, alkaloids and quercetin	Biopesticide
Cashew ( <i>Anacardium occidentale</i> )	Oil of the shells	Phenolic compounds	Biopesticide
Custard apple ( <i>Annona squamosa</i> )	Stems and leaves	Annonine	Biopesticide
Margosa ( <i>Azadirachta indica</i> )	Leaves, seeds and seed oil	Azadirachtin, nimbidin, salanin, meliantrol	Antifeedant, insect growth regularor and biopesticides
Flame of the forest ( <i>Butea monosperma</i> )	Extract flowers of	Chakcones and aurones	Termiticidal
Anjan ( <i>Hardwickia binata</i> )	Heartwood	Mopanol and epicatechin	Antifeedant
Madhuca ( <i>Madhuca latifolia</i> )	Seed and seed oil	Saponins	Repellent and biopesticides
China tree ( <i>Melia azedarach</i> )	Fruit and seed oil	Meliacin	Antifeedant and biopesticides
Pongam ( <i>Pongamia pinnata</i> )	Seed and seed oil	Karanjin	Repellent and biopesticide

# **Some Commercial Biopesticides in Indian Market**



# **Promotion and effectiveness of Integrated Pest Management and Biopesticides**

- **The Ministry of Agriculture and the Department of Biotechnology are responsible for promoting bio-pesticides, the former via the Central IPM Centre (Faridabad), the National Centre for IPM (NIPM) under the Indian Council For Agricultural Research (ICAR) and the Directorate of Biological Control.**
- **As a part of the Department of Biotechnology's demonstration programme, biopesticides have been demonstrated on about 55,000 hectares (Wahab, 1998).**

# **Farmers' Perspectives in Using Biopesticide and Integrated pest Management (IPM) in Agriculture in India**

***Although bio-pesticides and bio-control agents are important components of IPM being conducted by farmers but very little emphasis on these agents.***

***The main reasons for this are:***

- 1. Lack of awareness.***
- 2. Lack of skills***
- 3. Lack of faith in IPM.***
- 4. IPM practices are difficult and cumbersome***
- 5. Lack of proper training***

# **Antibiotic/Antimicrobial**

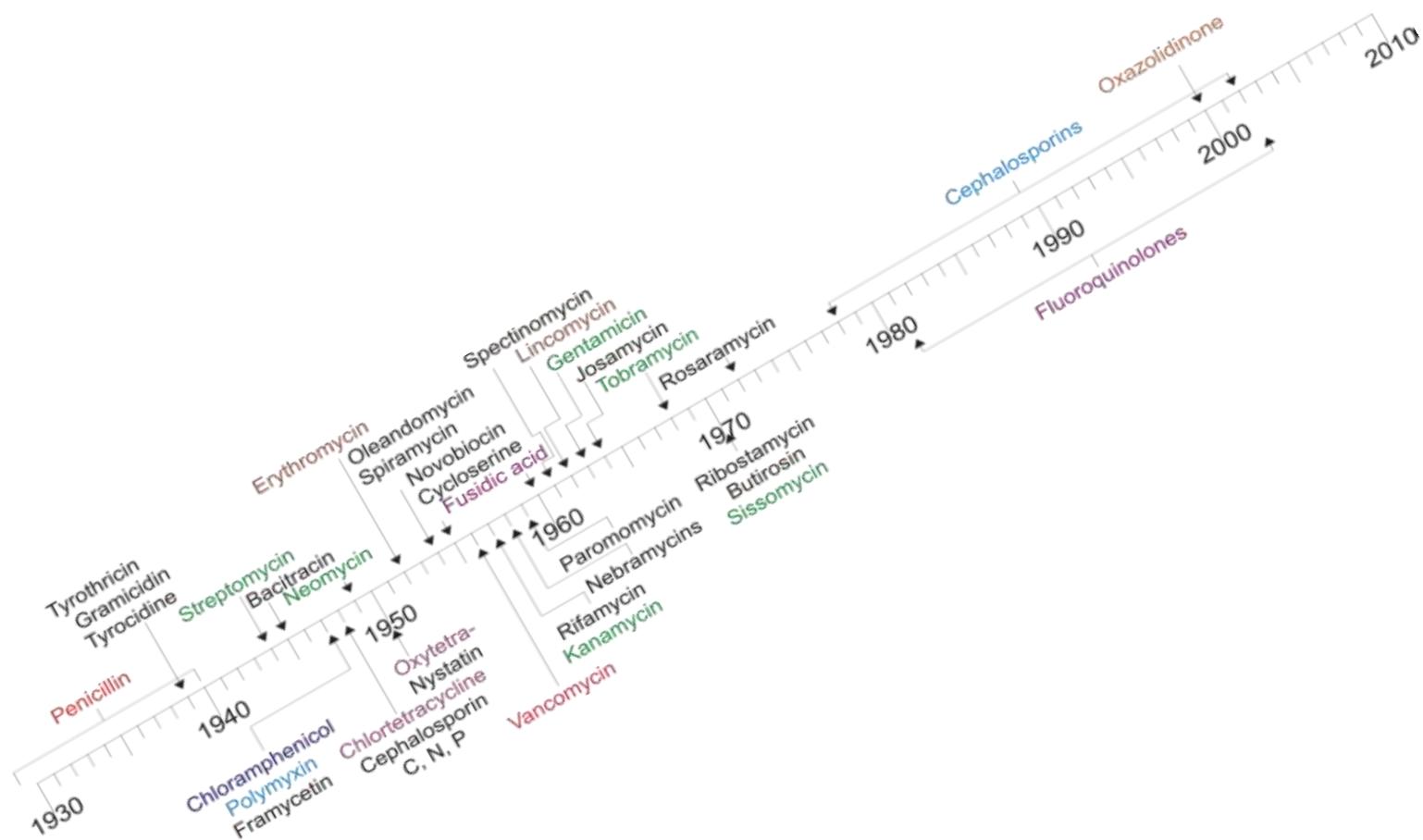
- **Antibiotics:** Bio-chemicals produced by a microorganism that kills or inhibits the growth of another microorganism
- **Antimicrobial agent:** Chemical that kills or inhibits the growth of microorganisms

# **20<sup>th</sup> Century**

## ***Golden age of Antibiotics***

- ***Discovery***
- ***Development***
- ***Clinical exploitation***
- ***Commercial production***
  
- ***Arguably the most significant medical advancement of the century***
- ***Considerable pharmaceutical investment***
  - ***11 distinct antibiotic classes***
  - ***>270 antibiotics in clinical use***

# **20<sup>th</sup> Century –the Golden Age of Antibiotics**



# **Antibiotic Discovery and Resistance**

<b>Agent</b>	<b>Year approved</b>	<b>Resistance first reported (year)</b>
<b>Penicillin</b>	<b>1943</b>	<b>1940</b>
<b>Streptomycin</b>	<b>1947</b>	<b>1947</b>
<b>Tetracycline</b>	<b>1952</b>	<b>1956</b>
<b>Vancomycin</b>	<b>1952</b>	<b>1987</b>
<b>Methicillin</b>	<b>1960</b>	<b>1961</b>
<b>Nalidixic acid</b>	<b>1964</b>	<b>1966</b>
<b>Gentamicin</b>	<b>1967</b>	<b>1969</b>
<b>Cefotaxime</b>	<b>1981</b>	<b>1981 (AmpC) 1983 (ESBL)</b>
<b>Ciprofloxacin</b>	<b>1988</b>	<b>1987</b>
<b>Linezolid</b>	<b>2000</b>	<b>1999</b>
<b>Daptomycin</b>	<b>2003</b>	<b>-</b>

# **21<sup>st</sup> Century**

- ***Prospects of a post-antibiotic era?***
- ***Evolving resistance with antibiotic use***
- ***Emergence of superbugs***
- ***Unmet needs of the hospital treatment market***
- ***Unrestricted use of antibiotics***
- ***High costs of development of new antibiotics***
- ***No new antibiotic since last two decades***

## ***Microbial Sources of Major Antimicrobials***

# ***Major Microbial Sources of Antibiotics***

<b>Microorganism</b>	<b>Antibiotic</b>
<b>Gram-Positive Rods</b>	
<i>Bacillus subtilis</i>	Bacitracin
<i>Bacillus polymyxa</i>	Polymyxin
<b>Actinomycetes</b>	
<i>Streptomyces nodosus</i>	Amphotericin B
<i>Streptomyces venezuelae</i>	Chloramphenicol
<i>Streptomyces aureofaciens</i>	Chlortetracycline and tetracycline
<i>Streptomyces erythraeus</i>	Erythromycin
<i>Streptomyces fradiae</i>	Neomycin
<i>Streptomyces griseus</i>	Streptomycin
<i>Micromonospora purpureae</i>	Gentamicin
<b>Fungi</b>	
<i>Cephalosporium</i> spp.	Cephalothin
<i>Penicillium griseofulvum</i>	Griseofulvin
<i>Penicillium notatum</i>	Penicillin

# ***Antibiotic Spectrum of Activity***

## ***Antimicrobial Spectrum of Important Antibiotics***

Prokaryotes				Eukaryotes			Viruses
Mycobacteria*	Gram-Negative Bacteria	Gram-Positive Bacteria	Chlamydias, Rickettsias†	Fungi	Protozoa	Helminths	
		← Penicillin →		← Ketoconazole →		← Niclosamide → (tapeworms)	
	← Streptomycin →			← Mefloquine → (malaria)			← Acyclovir →
		← Tetracycline →			← Praziquantel → (flukes)		
	← Isoniazid →						

\*Growth of these bacteria frequently occurs within macrophages or tissue structures.

†Obligately intracellular bacteria.

Copyright © 2004 Pearson Education, Inc., publishing as Benjamin Cummings.

***No antibiotic is effective against all microbes***

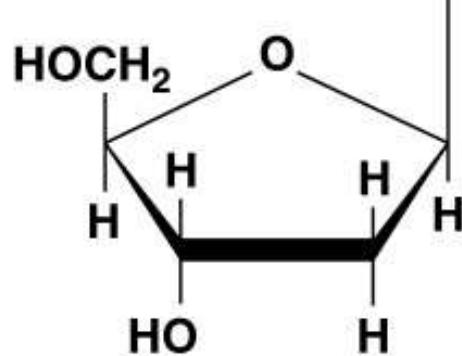
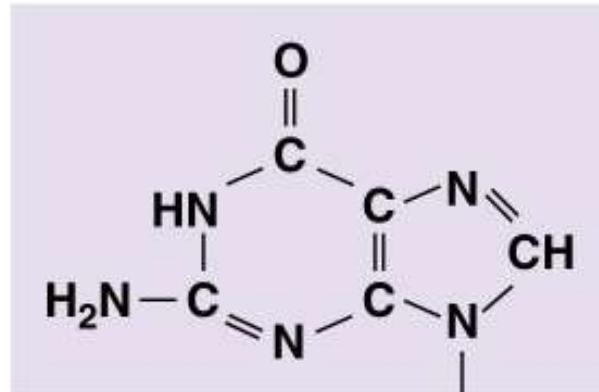
# **Antiviral Drugs**

- **Viruses are composed of nucleic acid, protein capsid, and host membrane containing virus proteins**
- **Viruses live inside host cells and use many host enzymes**
- **Some viruses have unique enzymes for DNA/RNA synthesis or protein cutting in virus assembly**

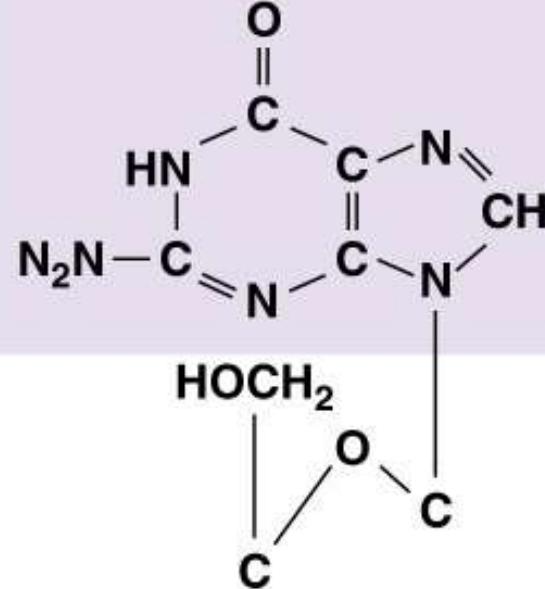
# *Antiviral Drugs*

## *Nucleoside and Nucleotide Analogs*

Guanine



Deoxyguanosine



Acyclovir

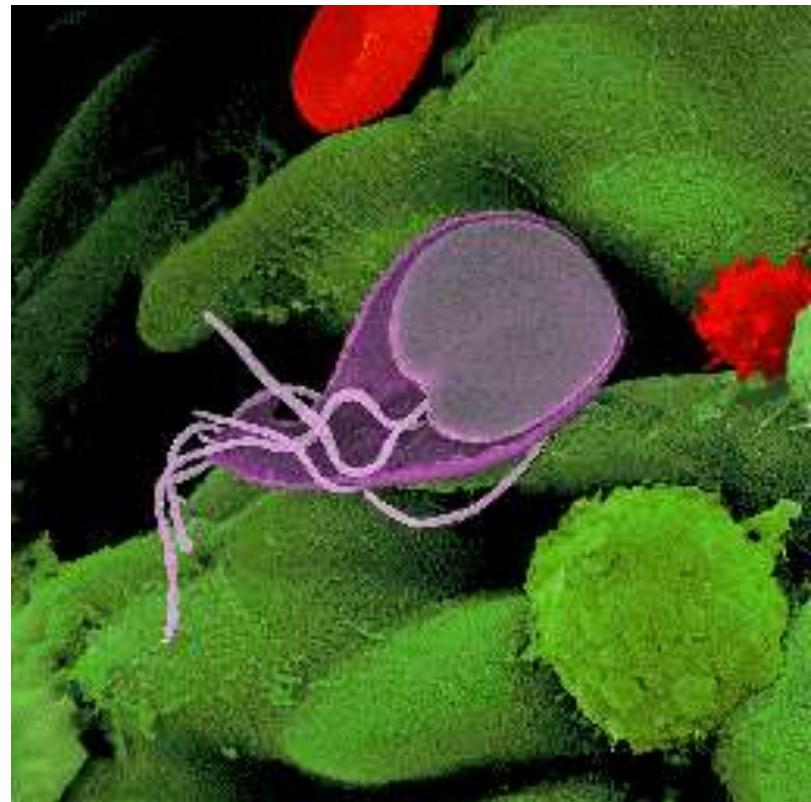
(a) Structural resemblance between acyclovir and guanine-containing nucleoside

# ***Antiviral Drugs - Enzyme Inhibitors***

- ***Inhibit assembly***
  - ***Indinavir (HIV)***
- ***Inhibit attachment***
  - ***Zanamivir (Influenza)***
- ***Inhibit uncoating***
  - ***Amantadine (Influenza)***
- ***Interferons prevent spread of viruses to new cells (Viral hepatitis)***
- ***Natural products of the immune system in viral infections***

# ***Antiprotozoan Drugs***

- ***Protozoa are eukaryotic cells***
- ***Many drugs are experimental and their mode of action is unknown***



# ***Antihelminthic Drugs***

- ***Prevent ATP generation  
(Tapeworms)***
- ***Alters membrane permeability  
(Flatworms)***
- ***Neuromuscular block (Intestinal roundworms)***
- ***Inhibits nutrient absorption  
(Intestinal roundworms)***
- ***Paralyzes worms (Intestinal roundworms)***

# **Negative Impact of Resistance on Health**

- **Longer duration of illness**
- **Longer treatment**
- **Higher mortality**
- **Treatment with expensive drugs**
- **Increased burden on health system**
- **Negates technological advances in medical sector**
  - **Complex surgeries**
  - **Transplantations and other interventions**
- **Patient acts as reservoir of resistant organisms which are passed to community and health-care workers**
- **Huge economic impact**



**THANK YOU**  
for your  
**ATTENTION!**