Chemical Technology
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Module - 9
Dye and Pesticide
Lecture - 1
Pesticides

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Today we will be discussing about the module 9 of the organic chemical technology course. And this module will have 2 lectures: one is on the pesticide; another is dye stuff and the intermediate. These are the 2 very important sector of chemical industry. And very brief we will be discussing on the pesticide and dyes and intermediate. So, let us discuss the pesticide and this is you can see the type of the pesticide, types of the insecticide, different types of the insecticides we are using in our daily life also, and apart from the pesticide they have played a very important role in the green revolution and the whatever the food grain and crops we are seeing this is only the because of the pesticides which we are using, because the fertilizer in the pesticide. These 2 have played important role in the green revolution.

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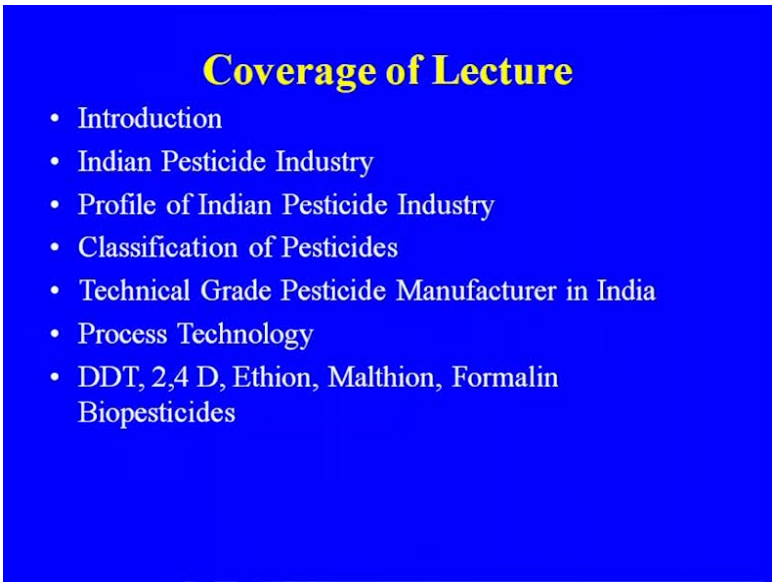

Coverage of the lecture, so for the pesticide is concerned we will be discussing about the general introduction of the pesticide industry, Indian pesticide industry, profile of Indian pesticide industry, classification of the pesticides because we are having the different type of pesticide and depending upon how they are working and the target insect what type of the target material is there and depending upon that the various pesticide they have been developed.

Technical grade pesticide manufacturer in India list of the and then the what are the raw material what are the process involved and some of the important pesticide which we are using that is the one is the DDT. Although, DDT is banned but we will be discussing still we are making DDT and the 2, 4 D that is the herbicide ethion, malathion, formalin, biopesticide and also the bezene hexachloride, the gamma isomer of the benzene hexachloride gamma large amount of this we are using.

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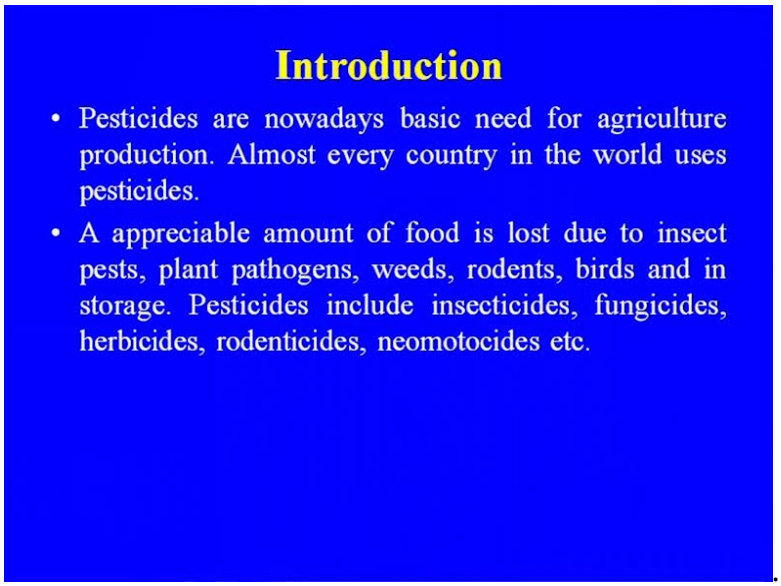

So, we will be discussing these things. So, let us discuss about the general pesticide. Pesticides are now a day's basic need of the agriculture production; almost every country in the world uses pesticides. A appreciable amount of food is lost due to insect pests, plant pathogens, weeds, rodents birds and storage. Pesticide includes insecticides, fungicides, herbicides, rodenticides, neomotocides etcetera. So, various grades of the pesticide we are manufacturing just to meet the demand and to control the insect.

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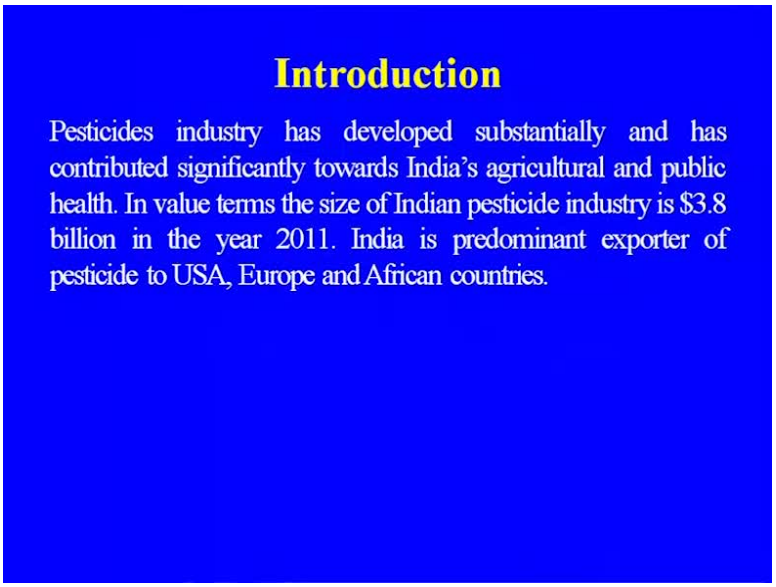

So, pesticide industry has developed substantially and has contributed significantly towards the India's agriculture and public health. In value terms the size of Indian pesticide industry is 3.8 billion dollar in the year 2011. India is predominant exporter of the pesticide to USA, Europe and African countries.

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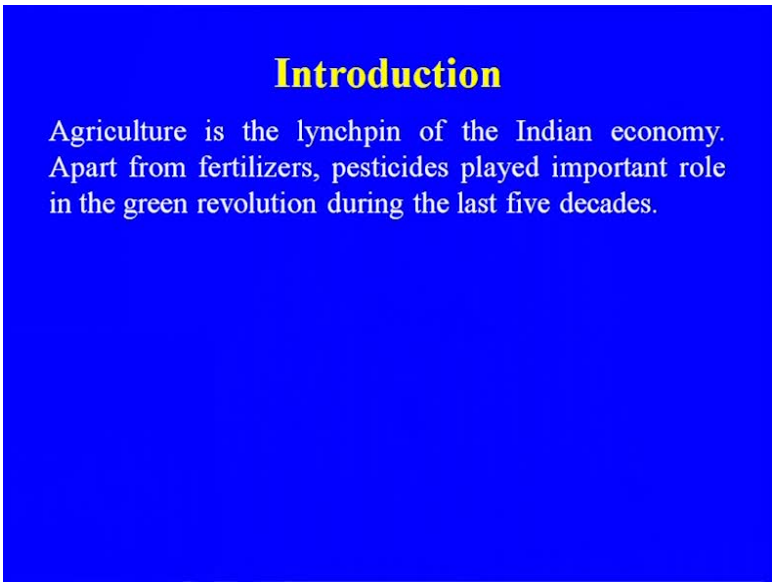

Agriculture is the lynchpin of the Indian economy. Apart from fertilizers, pesticide played important role in the green revolution during the last 5 decades.

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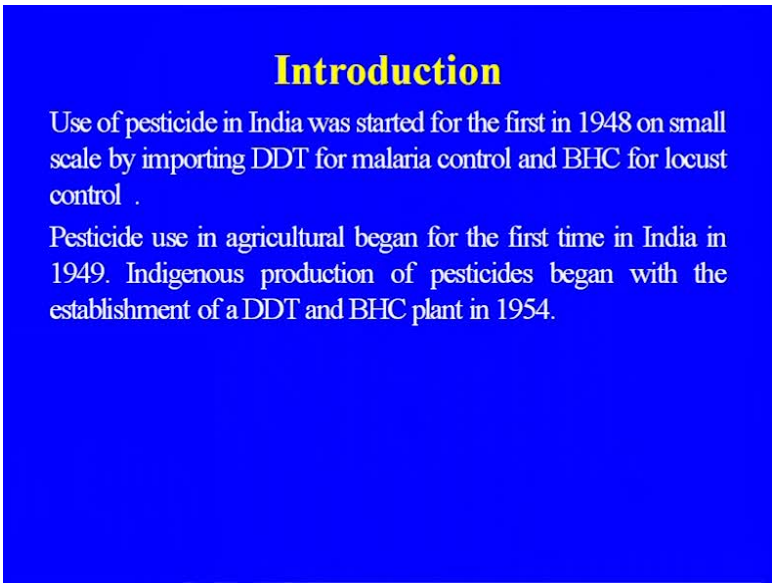

Use of the pesticide in India was started for the first in 1948 on the small scale by importing DDT for malaria control and BHC for the locust control. Pesticide using the agriculture began for the first time in India in 1949. Indigenous production of the pesticide began with the establishment of DDT and the BHC benzene hexa chloride plant in 1954.

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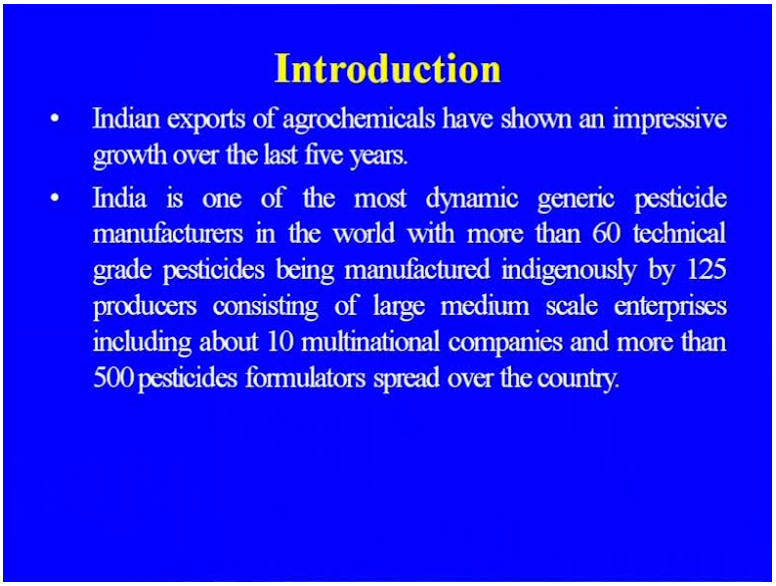

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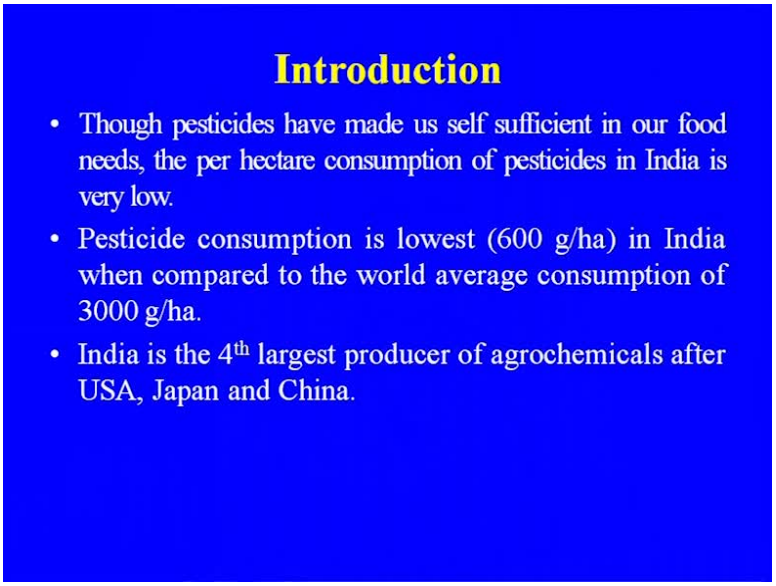

Indian exports of the agro chemicals have shown an impressive growth over the last 5 years because the pesticide industry, also we call it the agro chemical industry. India is

one of the most dynamic generic pesticide manufacturers in the world with more than 60 technical grade pesticides being manufactured indigenously by 125 producers consisting of large medium scale enterprises including about 10 multinational companies and more than 500 pesticide formulators spread over the country.

Though the pesticide have made us self sufficient in our food needs, the per hectare consumption of the pesticide in India is very low. Pesticides consumption is lowest around 600 gram per hectare in India when compare to world average consumption of 3,000 gram per hectare. India is the fourth largest producer of the agrochemicals after USA, Japan and China.

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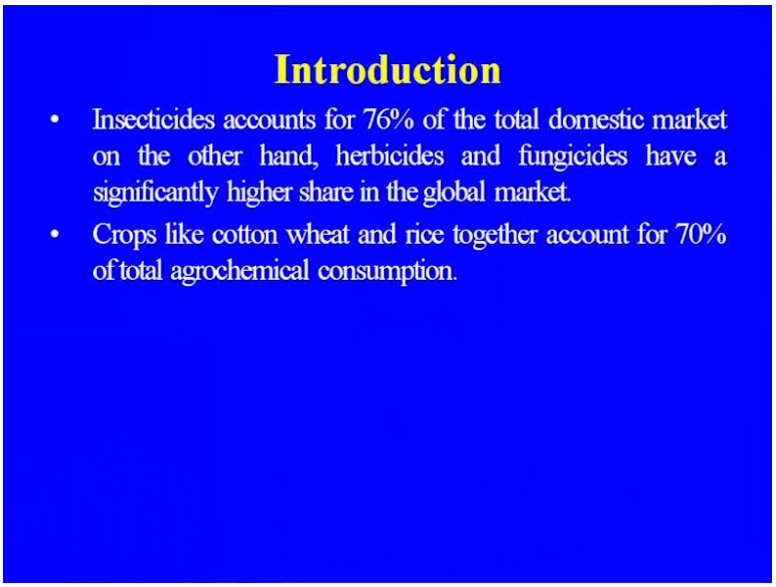

Insecticides accounts for 76 percent of total domestic market on the other hand, herbicides and fungicide have a significantly higher share in the global market. Crops like cotton wheat and rice together account for 70 percent of total agrochemical consumption.

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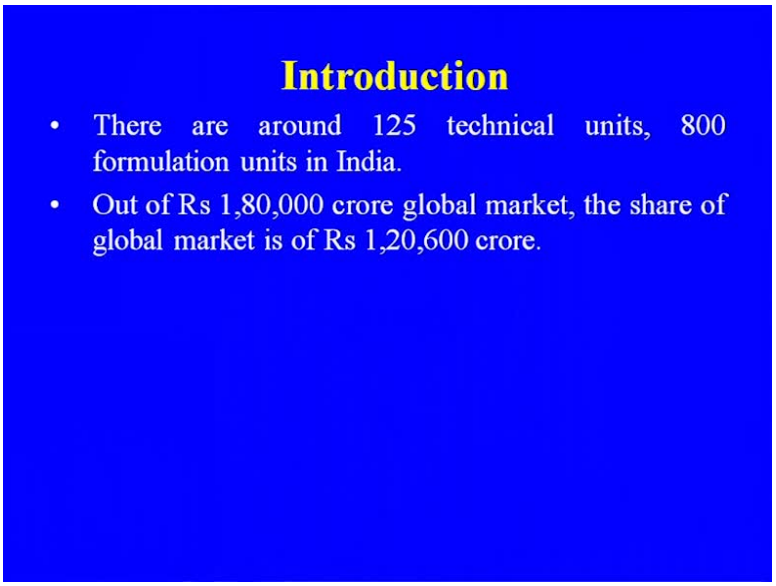

There are around 125 technical units, 800 formulation units in India. Out of rupees 180000 crore global market, the share of the global market is of 120600 crore.

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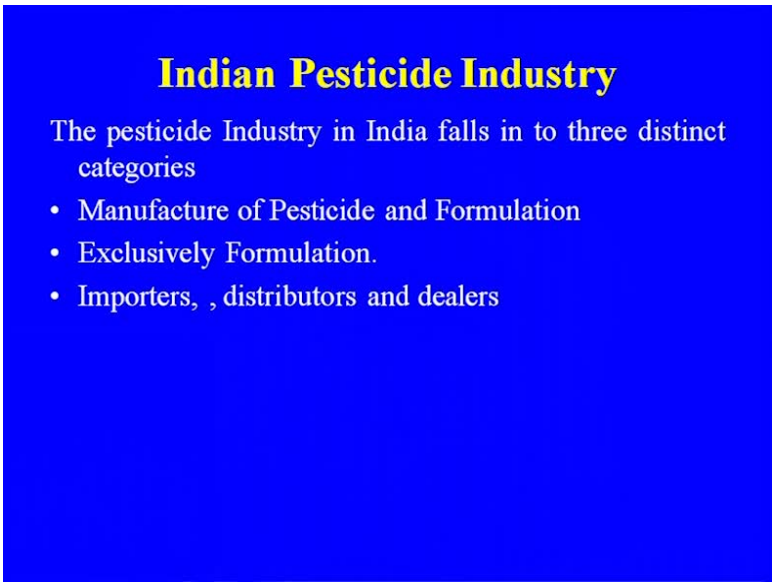

The pesticide industry in India falls into 3 distinct categories means, the manufacture pesticide and formulation exclusively, formulation because many small units are there which are taking the final products and doing the formulation. Importers distributors and dealers this is the status of the pesticide industry in India.

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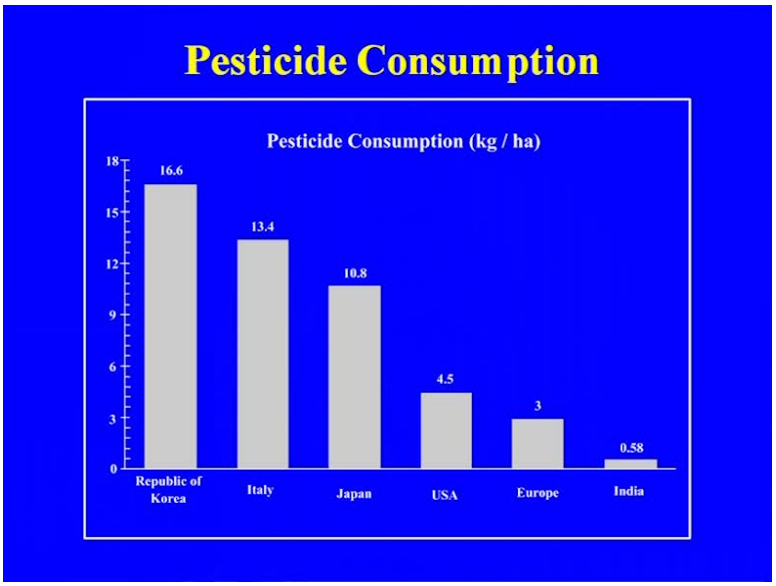

This is the pesticide consumption. If you compare here, the India is the lowest figure 0.5 kg if you compare with the republic of Korea, Italy and Japan. And so, you can just imagine our consumption per hectare is much less than other developed country.

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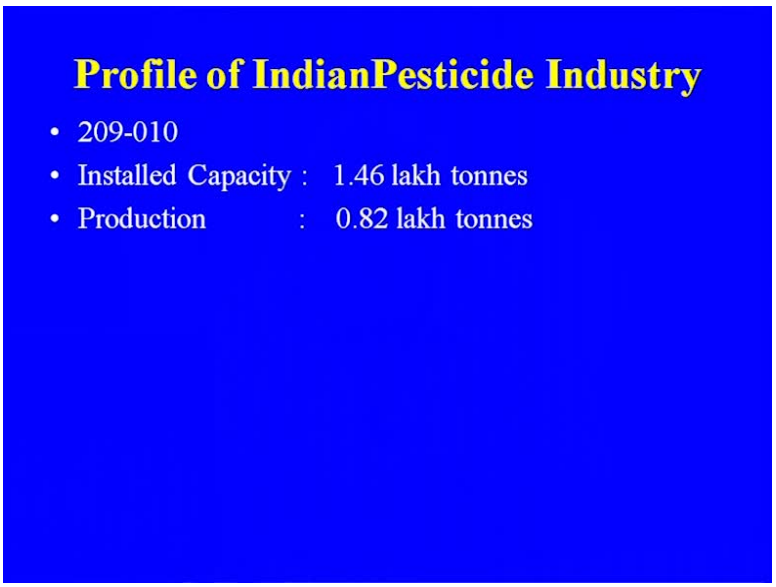

Profile of Indian pesticide industry in 2009-10, the installed capacity was 1.46 lakh tonnes, production was 0.82 lakh tonnes.

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Profile of IndianPesticide Industry (000' MT)

Major groups / Products	Installed Capacity		Production	
PESTICIDES &INSECTICIDES	2009-10	2002-03	2009-10	2010-11
D.D.T.	6.30	2.94	3.61	3.09
Malathion	8.80	4.25	0.62	0.64
Parathion (methyl)	4.00	2.04	0.00	0.00
Dimethoate	3.20	0.76	0.96	1.12
D.D.V.P.	2.51	3.46	3.12	3.13
Quinalphos	4.00	1.77	0.99	1.01
Monocrotophos	14.00	6.52	5.74	8.60
Phosphamidon	3.90	0.84	1.00	0.03
Phorate	8.20	3.16	2.00	2.63

These are the different types of the pesticide which we are making the pesticides, insecticides. So, here it is the DDT, Malathion, Parathion, Dimethoate, D.D.V.P, Quinalphos, Monocrotophos, Phosphamidon, Phorate.

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Ethion	5.60	1.68	0.43	0.65
Endosulphan	9.90	3.66	2.80	1.73
Fenvalerate	2.60	0.52	0.53	0.08
Cypermethrin	6.90	5.08	6.23	4.95
Anilophos	1.10	0.35	0.00	0.00
Acephate	9.20	4.84	1.083	12.84
Chlorpyriphos	9.10	6.40	2.90	3.35
Phosalone	1.00	0.44	0.00	0.00
Metasystox	*	0.51	0.00	0.00
Fenthion	*	0.91	0.00	0.00
Triazophos	*	1.15	1.00	1.58

Ethion, endosulphon, fenvalerate, cypermethrin, anilophos, acephate, chloropyriphos, phosalone, metasystox, fenthion, triazophos.

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Lindane	0.70	0.33	0.00	0.00
Temephos	0.20	0.12	0.00	0.00
Deltamethrin	0.50	0.21	0.02	0.00
Alphamethrin	1.50	0.19	0.00	0.51
Captan&captafol	1.80	0.78	0.00	0.00
Ziram (thiobarbamate)	0.50	0.00	0.00	0.00
Carbendzim (bavistin)	1.50	1.26	0.19	0.26
Calixin	0.20	0.05	0.00	0.00
Mancozab	20.70	10.19	31.49	26.05
Copper-oxychloride	1.50	0.24	0.00	0.00

So, different grades of the lindane, temephos, deltamethrin, alphamethrin, captan and captafol, ziram, carbendzim, calixin, mancozab, copper-oxychloride.

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2,4-D	1.20	0.00	0.00	0.00
Butachlor	0.50	0.24	0.24	0.09
Isoproturon	5.40	2.66	2.91	3.90
Glyphosate	2.60	0.11	1.70	2.28
Diuron	0.10	0.05	0.13	0.20
Atrazin	0.50	0.20	0.26	0.24
Fluchloralin	0.20	0.19	0.00	0.00
Zinc phosphide	0.90	0.24	0.33	0.42
Aluminium	2.30	1.99	2.16	1.80
Dicofol	0.20	0.10	0.02	0.043
Total	146.20	69.57	82.19	81.22

Annual report 2010-11, Ministry of Chemical & Fertiliser

These are the some of the figures you can go through the production, consumption and the 2, 4-D, butachlore and isoproturon, glyphosate, diuron, atrazin, fluerochloralin, zinc phosphide, aluminium compounds are also there, dicofol and total is around 146.2 thousand tons. This is from the data that is available on the website of the ministry of chemical and fertilizer.

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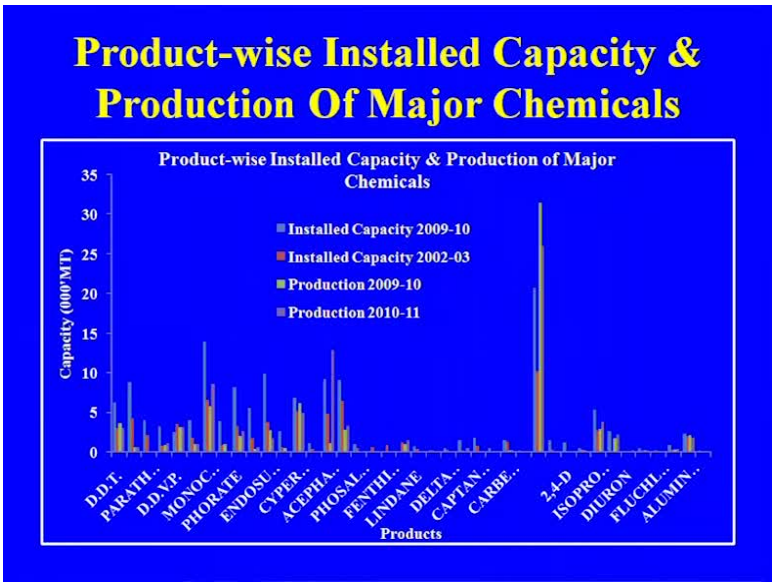

This is the product wise installed capacity and production of the major chemicals during the 2009-10, 2002-03 comparison that has been given and the production of figure of the 2009-10. And different pesticide that we are making that is given there.

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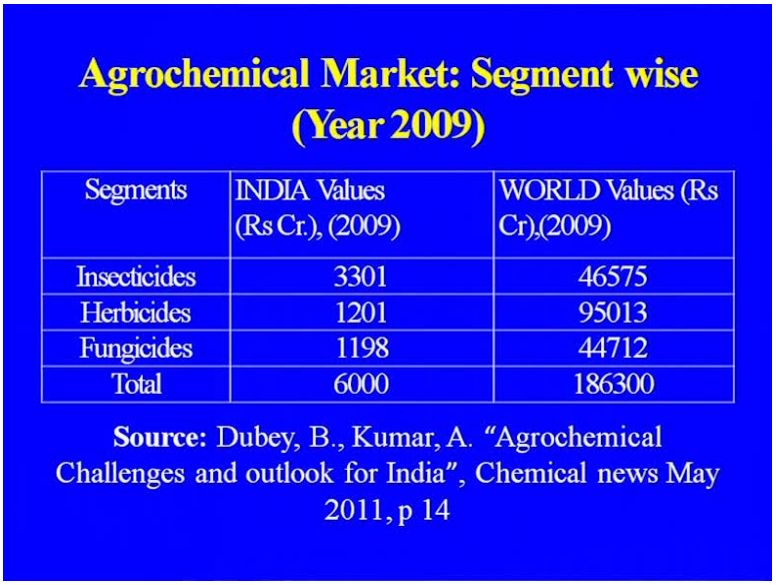

So, this is the agro chemical market segment wise. Insecticide, herbicide and fungicide so, these are the 3 major category of the pesticides that we are using. So, India values in the terms of rupees crore and the world values in terms of. So, you can see the

percentage is much less of the total consumption but still the share is of the insecticide then it is the herbicide and the fungicides.

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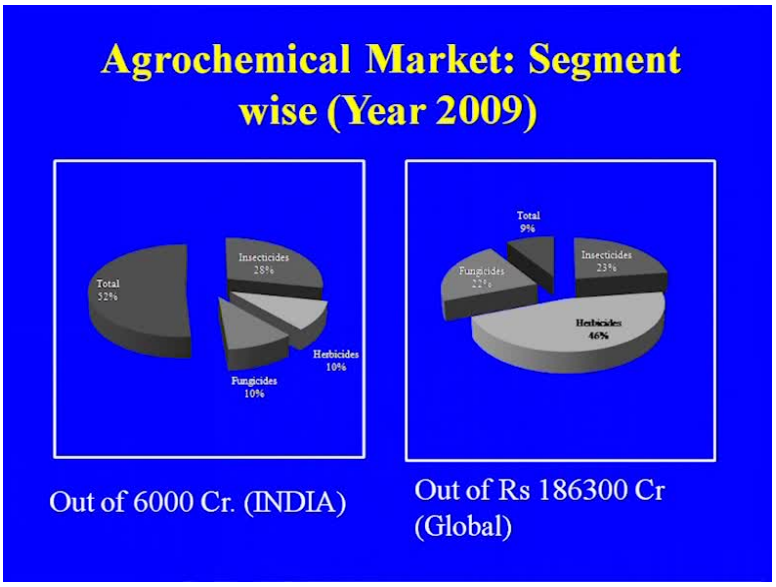

Agro chemical market segment wise, these are the 3 major pesticide, Insecticide, herbicide and fungicide that we are using and the amount that you can see the major share is of the insecticide and then the herbicide and fungicide.

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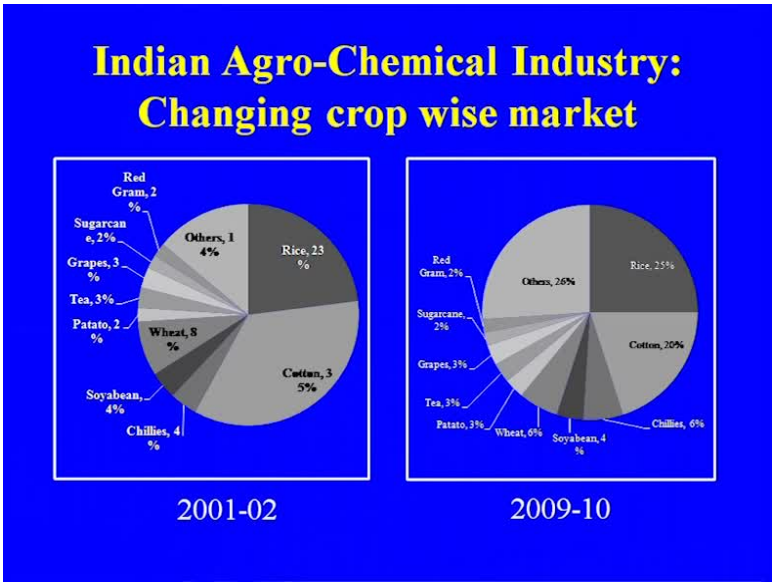

This is the segment wise total consumption of the various insecticides that is there, that is given there. Here, if you see this figure from, this figure it is clear that the major portion

of the pesticide or the agrochemical industry, that is the rice that is major consumer and the cotton is the highest. But, the consumption in the cotton that has because this will again depend upon the type of the crops we are producing. And rest of the things you will be seeing that the other sugarcane or the grapes or the potato, wheat, it is much less than in comparison to rice, straw rice and the cotton.

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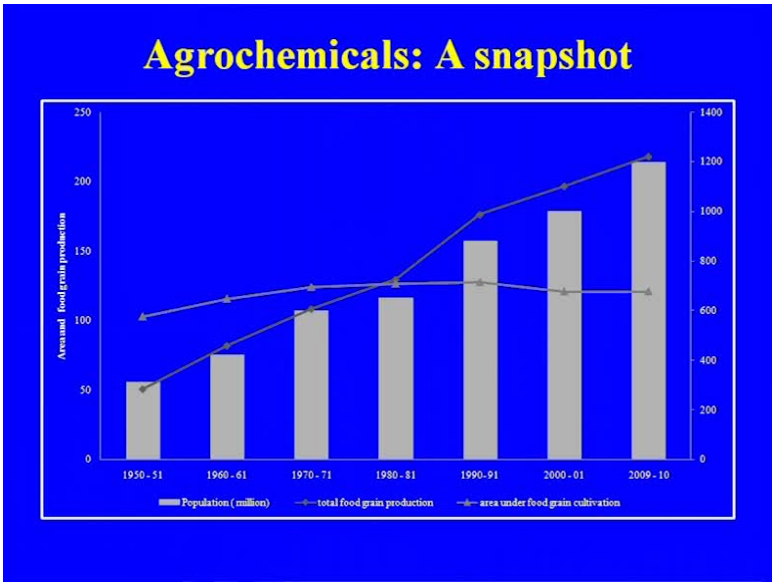

Ah this is about the again the population and the total food grain production and the area under the food grain cultivation, about the how the food crop pattern that we are having in India. So, the about the as I told you the pesticide that has been playing a very important role in the green revolution and the increase in the food production that has been only, because of the availability of the pesticide and the manufacture of the various pesticides in India because that is also a appreciable amount that we are using along with the fertilizer, because now the requirement that has that has been changing with the type of the crop we are having.

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So, major pesticide manufacture this is not the complete. Some of the major pesticide manufacture list excel crop care limited, Hindustan insecticides limited, Coromandel international limited, Super crop safe limited and Amico pesticide limited, Nagarjun fertilizer and chemicals limited, Cyanamid agro limited, Hindustan insecticides, Shivalik rasayan, Southern pesticide.

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And other here large number, other numbers are also there because the vantech, hoechst because there here, some of the multinational companies are there, so Bayers, Rallis,

Indian organic chemical, Sandoz, United phosphorus this is one of the important actually the pesticide manufacture industry in the Gujarat, Lupin laboratory, ICI India, Kanoria chemicals which is started their BHC benzene hexa chloride plant near Ranikot in U.P, when the aluminium plant came there and so, lot of the requirement of sodium hydroxide was there. So, the caustic chlorine plant was set up at Rainkot and just to utilize the chlorine they started making the benzene hexa chloride also there. So, another companies the BASF India, EID parry. Now, let us see the classification of the pesticides because there are 2 how we are classifying the pesticide.

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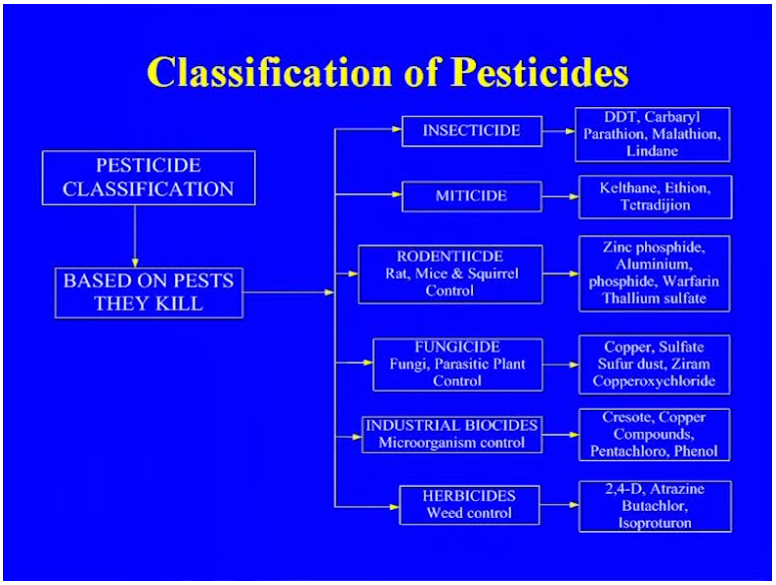

Pesticide classification is the based on the pest they kill, based on the pest they kill based on the pest they kill so, insecticide, miticide, rodentcide, fungicide, industrial biocide, herbicide and based on the chemical group because here it is based on the pest. So, insecticide, DDT, parathion, the carbaryl, malathion, the lindane, these are all the then the miticide, kelthane, the ethion so, number of rodentcide like rodentcide rat mice and the squirrel control fungicide fungi and the parasite plant control and the industrial biocides micro-organic control and herbicide for the wheat control. So, this is the based on the pest they control and this is the list of the various pesticides coming in this category. And the other pesticides are also there, it is just a few important pesticides in different groups that are given here.

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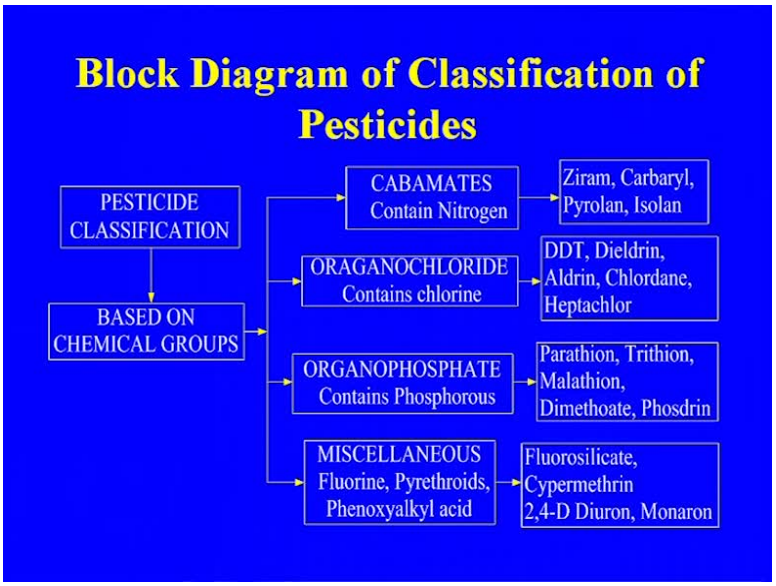

This is the pesticide classification based on the chemical group. The cabamate contain nitrogen. Organochloride contains chlorine. Organophosphate contains phosphorus and the miscellaneous fluorine, pyrethroids, phenoxyalkyl acid. And so, these are the some of the important pesticides which are coming in this group. The cabamates ziram, carbaryl, pyrolan, Isolan, DDT in the organic chloride, dieldrin, aldrin, chlorodane, heptachlor these are again organochloride. Parathion, trithion, malathion, dimethoate and phosdrin these comes in the organic organophosphate pesticide because here the phosphorus that is playing important role in the insect control. Miscellaneous fluorine here is the fluorosilicate, cypermethrin, 2, 4-D diuron, monaron. So, this is the classification of the pesticide based on the chemical groups.

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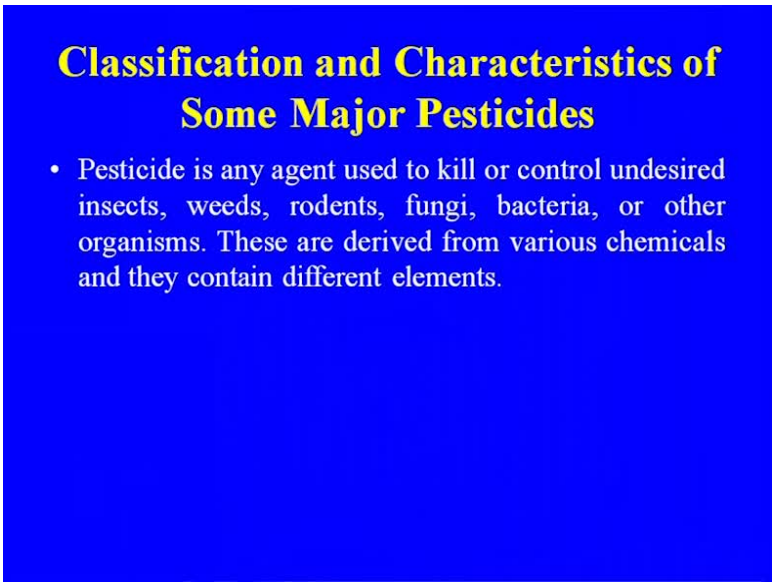

Pesticide is any agent used to kill or control undesired insects, weeds because different applications are there. The classification which has been given that is because you are using for insects, weeds, rodents, fungi, bacteria or other organisms. So, these are derived from various chemicals and they contain different elements.

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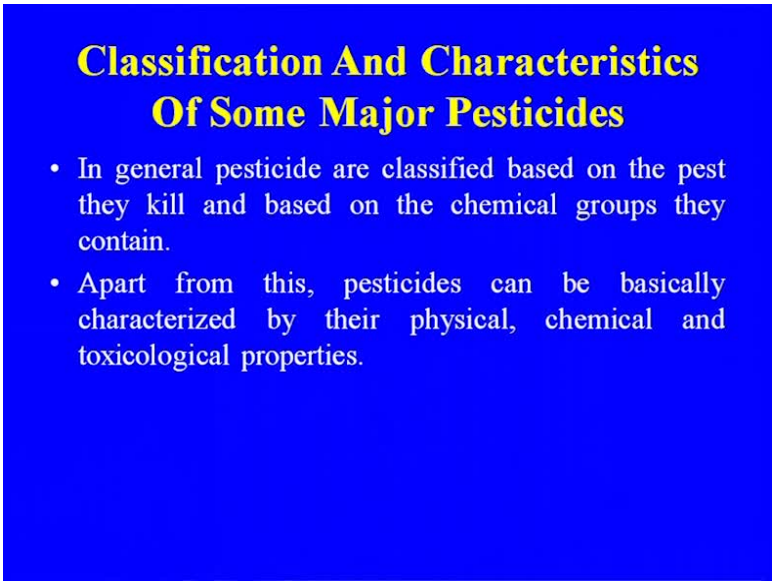

In general pesticides are classified based on the pest they kill and based on the chemical group they contain. So, already we have discussed about the classification based on both.

Apart from this pesticide can be basically characterized by their physical, chemical and toxic toxicological properties also.

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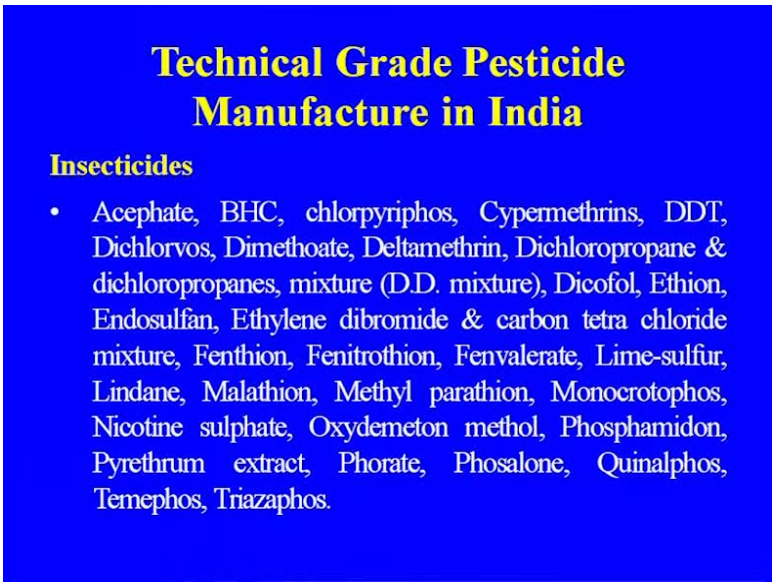

These are the technical grade pesticide manufacture in India acephate, BHC, chloropyriph, Cypermethrins, DDT, dichlorvos, dimethoate so, a large list. This is a dichloropropane and dichloropropanes mixture, dicofol, ethion, endosulfan, ethylene dibromide and carbon tetra chloride mixture, fenthion, fenitrothion. So, these are the large number of the insecticide we are having and some of the there we are different formulations are also there.

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Fungicide: These are the list of the fungicide that we are using, the aureofungin, copper oxychloride, copper sulphate, carbendazim, captafol, ferbam, mancozeb, nickel chloride, organomercurials, sulphur, streptocycline, thiram, tride, tridemorph, ziram and zineb.

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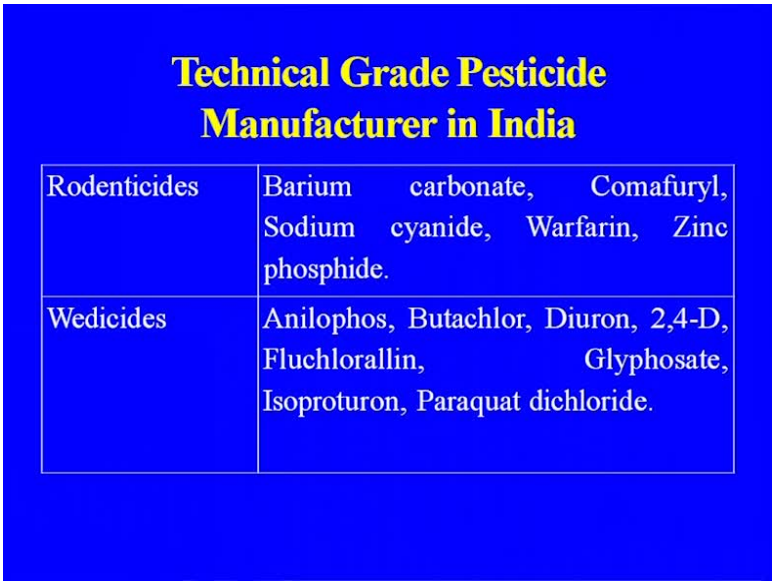

So, this is coming in the rodentcide, barium carbonate, comafuryl, sodium cyanide, warfarin, zinc phosphide, this is in the category of the rodentcides. Then the wedicides: Anilophos, butachlor, diuron, 2, 4-D, flurochlorine, glyphosphate, isoproturon, paraquat dichloride, these are coming in the category of the wedicides. Plant growth regulator

because what is happening we are having the different just like we need the different type of the nutrients.

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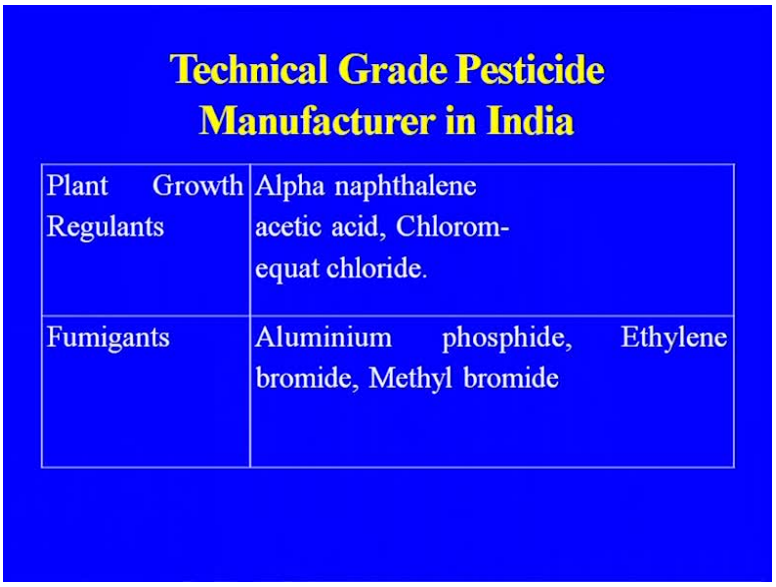

Similarly, different types of requirements are also there in case of the plant growth regulator that is there so, alpha naphthalene acetic acid, chlorom-equat chloride. Fumigants: aluminium phosphide, ethylene bromide, methyl bromide. So, this is the in brief about the property of the various pesticides because one of the major problem has been from the environmental constraint that is, from the environmental point of view because most of the pesticide they are highly toxic in nature and so these are the effects. If the DDT, already you see that there was ban because highly persistence. Some of the pesticides are highly persistence in nature and this is the reason because of which many of the pesticides that has been banned, there use has been banned and they are coming in the category of the hazardous waste that is notified by the ministry of environment and forest.

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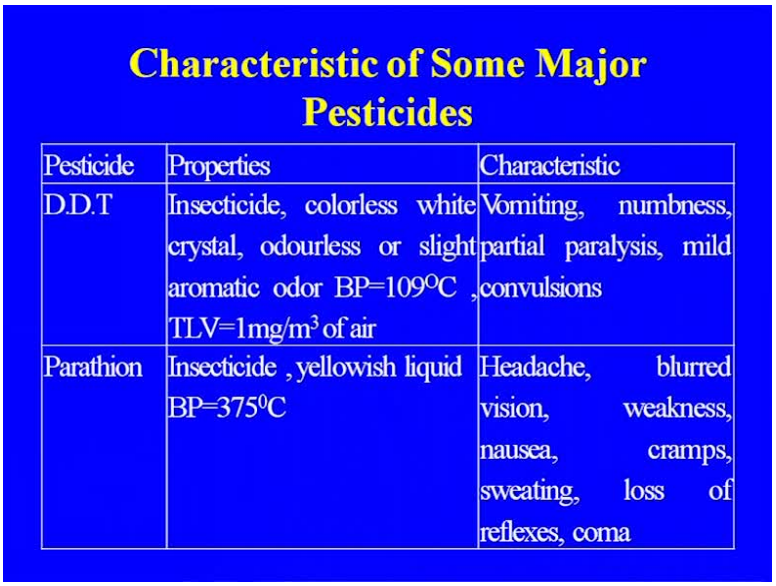

So, this is some of the effect of the DDT: Vomiting then partial paralysis, mild convulsions. And the parathion: headache, blurred vision, weakness, nausea, cramps, sweating, loss of the reflexes, coma.

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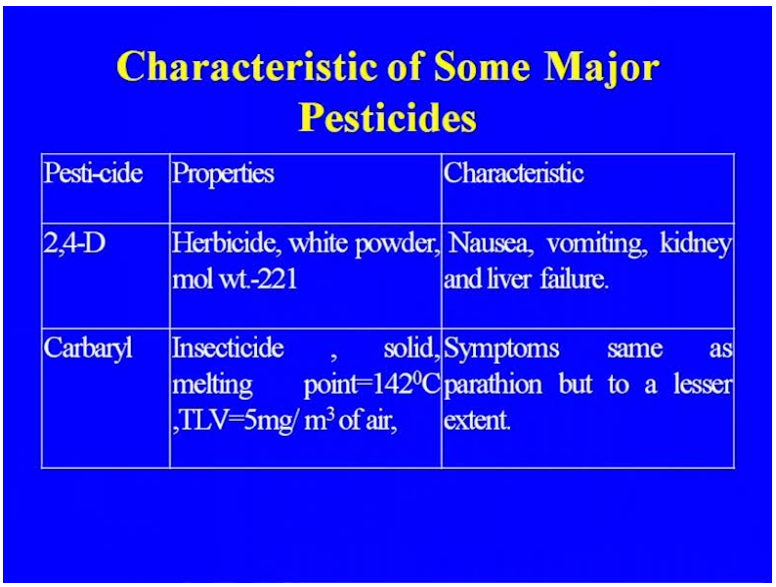

So, these are the 2,4-D again nausea, vomiting, kidney and liver failure that may be there. Carbaryl symptoms are same as the parathion but to a lesser extent. The properties also, that you can just see the properties but these are the some of the effect BHC. Because in case of the BHC we are using the gamma, isomer which is highly reactive

and at the same time highly toxic and normally, the various formulation having the carrier 5 percent gammaxine that we are using so, this because lot of the dust emission is there during the making of the that gamaxine powder. And so, lot of the people were working they are exposed, in all the cases they are exposed to the various pesticide and so, the chance and the toxicity and that may cause serious health effect.

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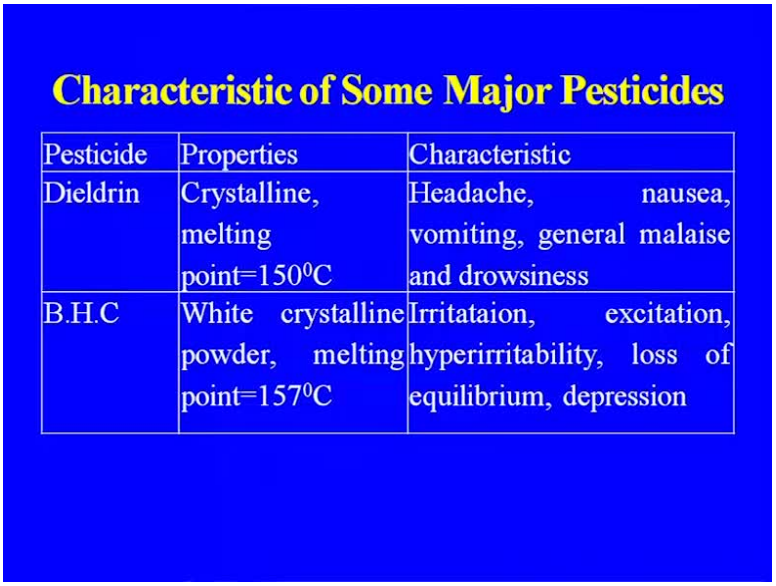

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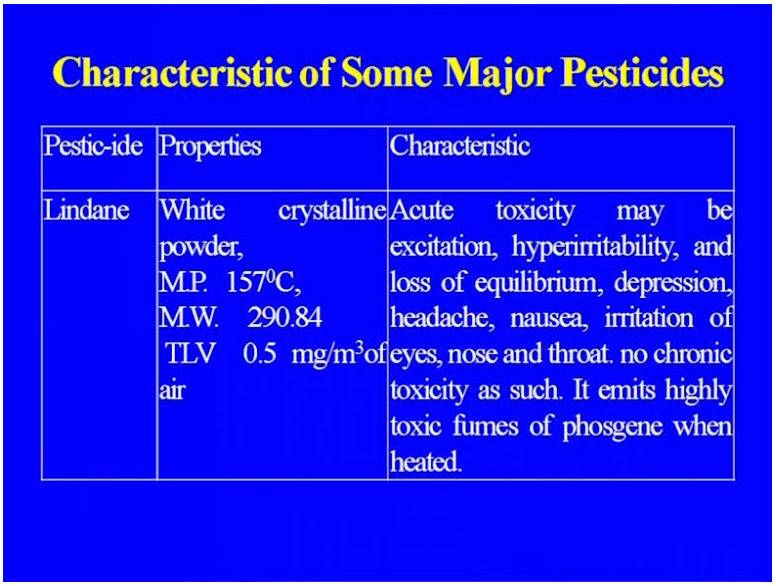

So, BHC: Irritation, excitation, hyperirritability, loss of equilibrium, depression all. Similarly, lindane: Acute toxicity may be excitation, hyperirritability and loss of the

equilibrium, depression, headache, nausea, irritation of the eyes, nose and throat, no chronic toxicity as such. It emits highly toxic fumes of the phosgene when heated.

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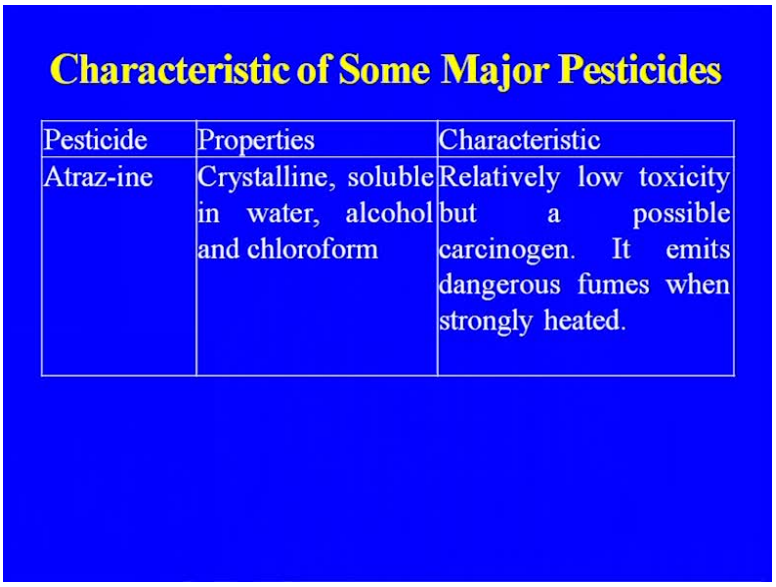

Here, about the properties the threshold value on that is given on the various pesticides. Atraz-ine: relatively low toxicity but a possible carcinogen. It emits dangerous fumes when strongly heated.

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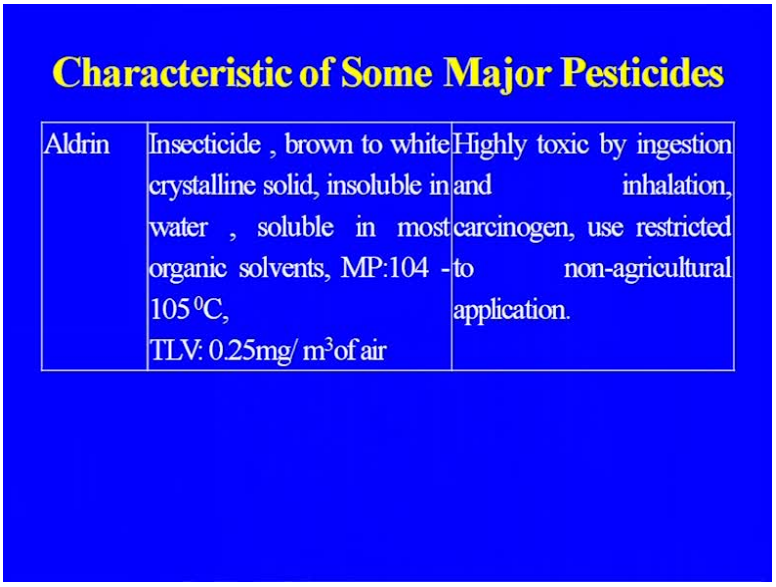

Aldrin: Highly toxic by ingestion and inhalation, carcinogen, use restricted to non-agricultural application because Aldrin that is highly toxic material.

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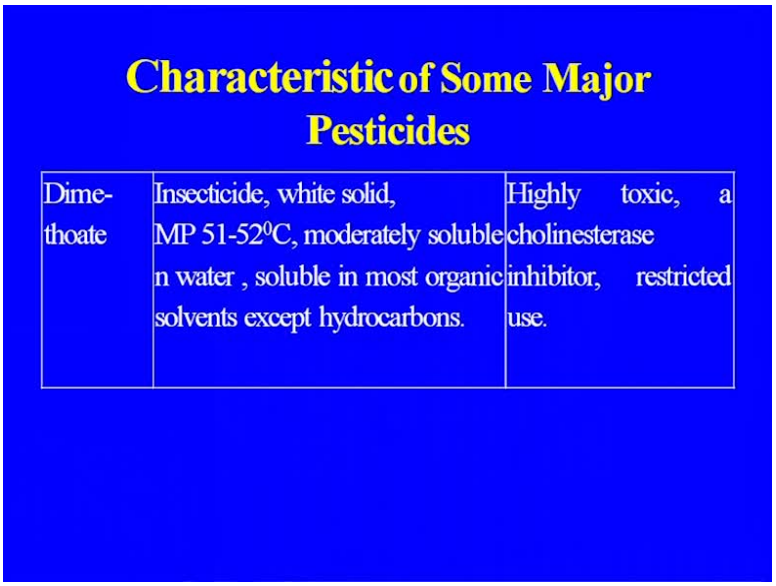

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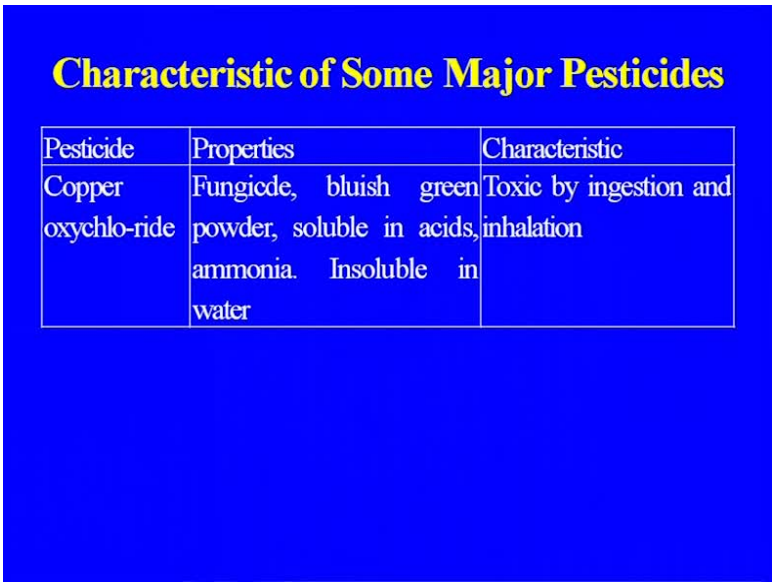

Dime-thoate: Highly toxic, a cholinestrerase inhibitor, restricted use. Copper oxychlo-ride: toxic by ingestion and inhalation, this is the properties fungicide, soluble in acids, ammonia, Insoluble in water.

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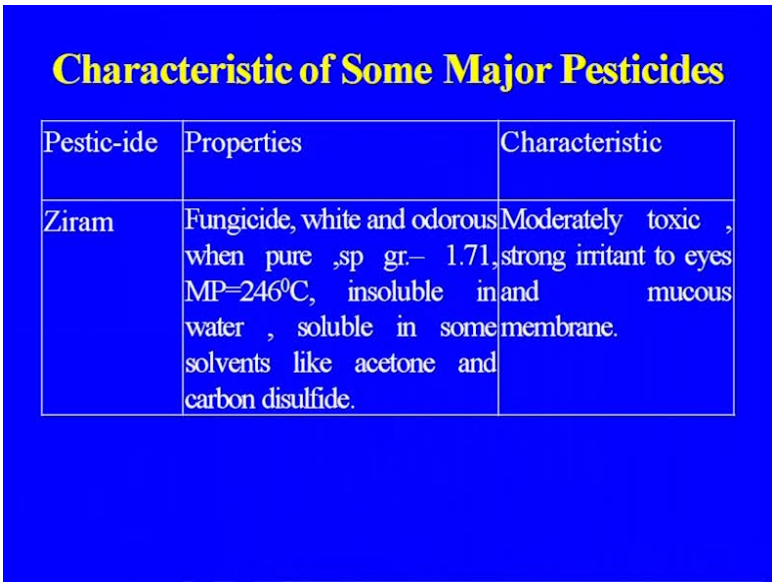

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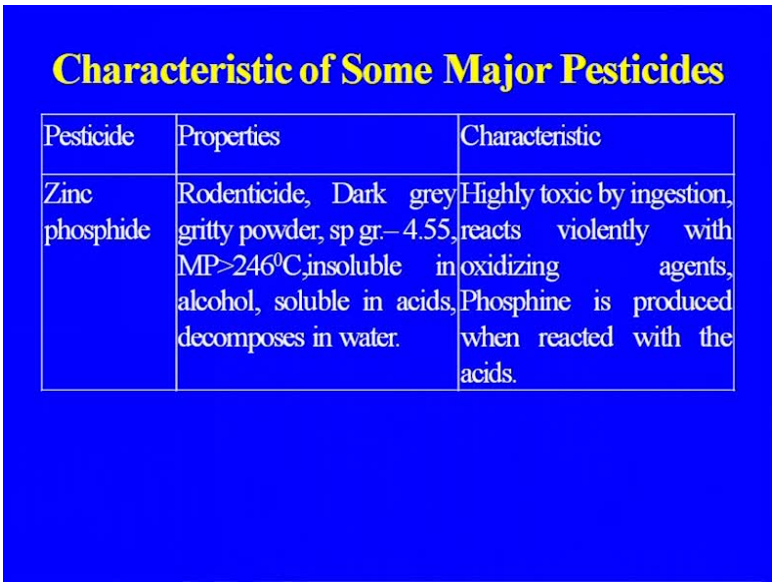

Ziram: moderately toxic, strong irritant to the eyes and mucous membrane. Similarly, zinc phosphide, so this is the again highly toxic. So, most of the pesticide you will see that they are highly toxic in nature so, proper precautions that is very important while using these pesticides. Now, let us discuss about the process technology that is involved in manufacture of the various pesticide insecticide.

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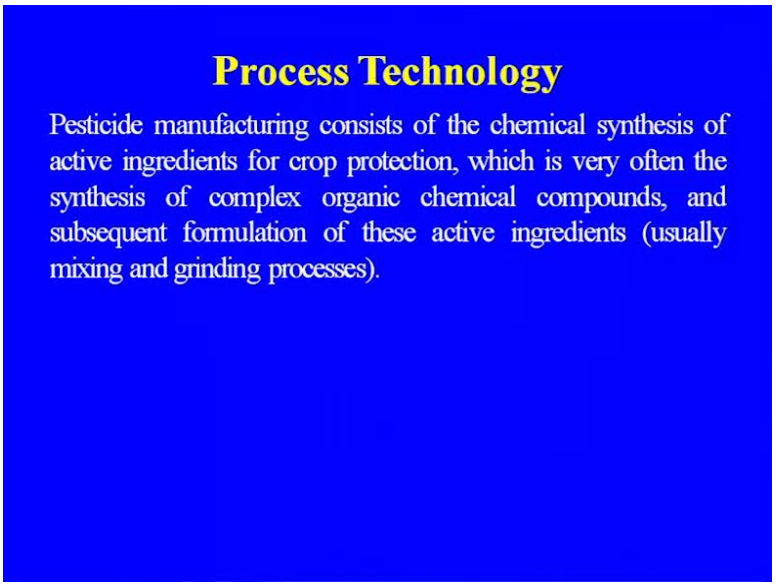

Pesticide manufacturing consists of chemical synthesis of the active ingredients for crop protection, which is very often in the synthesis of complex organic chemical compounds, and subsequent formulation of these active ingredients usually, mixing and grinding process.

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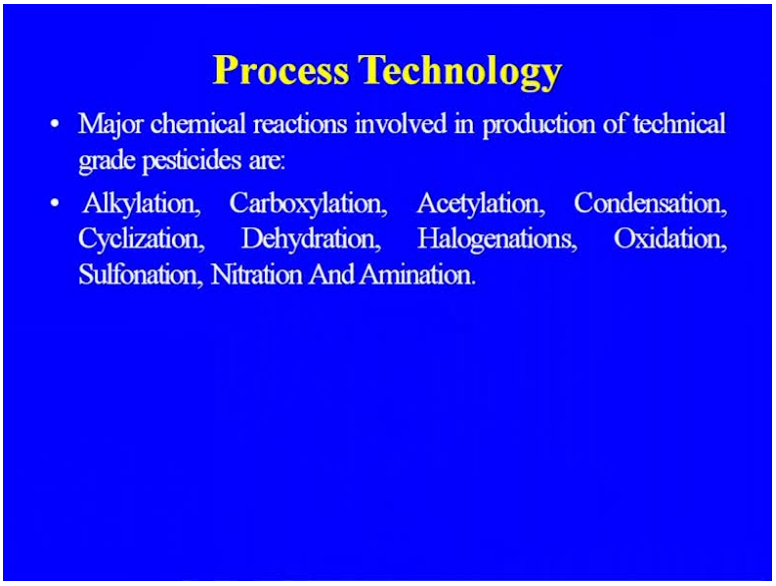

So, major chemical reactions involved in production of technical grade pesticides. These are the various because the basic raw material, I will be discussing the about that are the feed stock. But, basic raw material whether it is benzene or your pthalic anhydride or it

may be the xylenes, all those thing that is the benzele acid, phenol, herbis phenol so, all these are the basic raw material. But, these are the some of the additional process that is required to make the active ingredient of the pesticide.

The alkylation, carboxylation, acetylation, condensation, cyclization, dehydration, halogenations, oxidation, sulphonation, nitration and amination so, these are the some of the major unit process that is involved in making of the pesticide. So, this is because you see, as I told you earlier also we are having the a large number of the pesticide manufacture, some are making the basic ingredient of the pesticide, some are doing only formulation, some are doing the just like the dusting powder means where in the powder form you are getting, share taking the main ingredient and then they are doing the formulation by mixing the basic pesticide with the powder based mineral.

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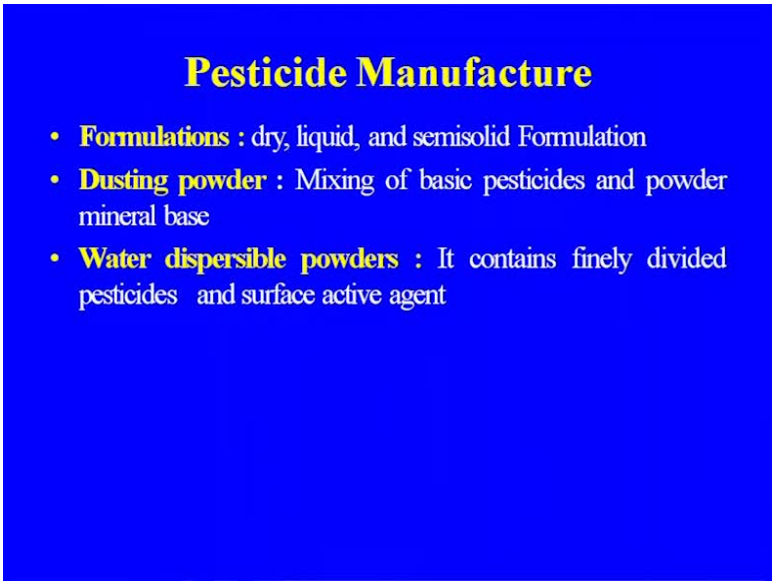

So, this is the formulation: dry, liquid and semisolid formulation that may be there. Dusting powder means just like you take the case of the benzene; there we are having some powder mineral base along with the soap stone powder finely the powdered. So, the planning and pulverising that is the one of the very important operation here in case of the making of the dusting powder. So, mixing of the basic pesticide and powder mineral base that is we are having mineral base means it may be soap stone or other some of the inert material, which is cheap, which should be cheap that is because this is

only the carrier. And the water dispersible powders it contains finely divided pesticides and surface active agent.

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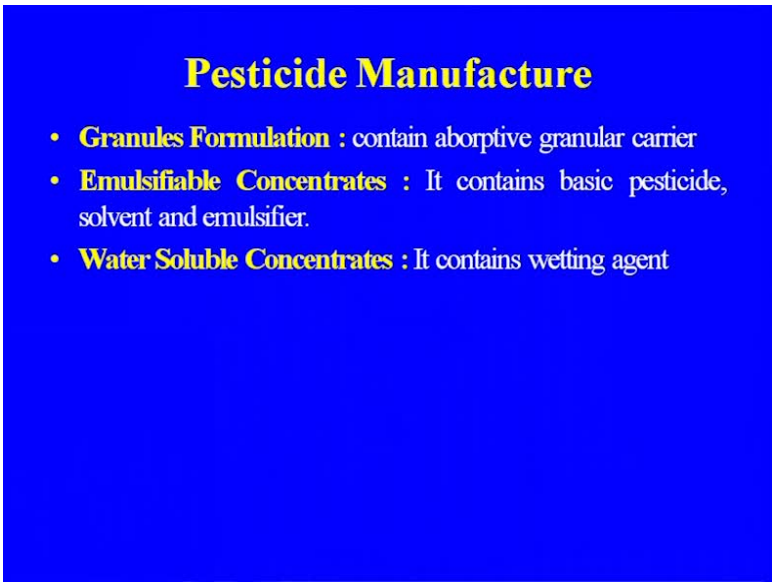

Then the another type of the formulation where, this is the granules formulation contain absorptive granual carrier where, the pesticide or absorb in the granuals and so the with that granual that we are using. Emulsifiable concentrates it contains basic pesticide solvent and emulsifier. Then another type of the water soluble concentrates it contains the wetting agent. So, this is the how the formulation of the pesticide or the making of the pesticide that is being apart from this the basic ingredient the pesticide.

So, we will be discussing some of the important pesticide that we are making not it will be not possible to cover every all the pesticide, insecticide, herbicide. But, only the in brief we will be discussing about that. Let us now discuss the one of the major actually, you can say the use of the DDT that was the first started and it was just to for the fighting against the malaria. So, DDT were but because of this persistence nature in the environment now there is ban on the use of DDT but still we are manufacturing and using the DDT but in other development there is ban on the DDT.

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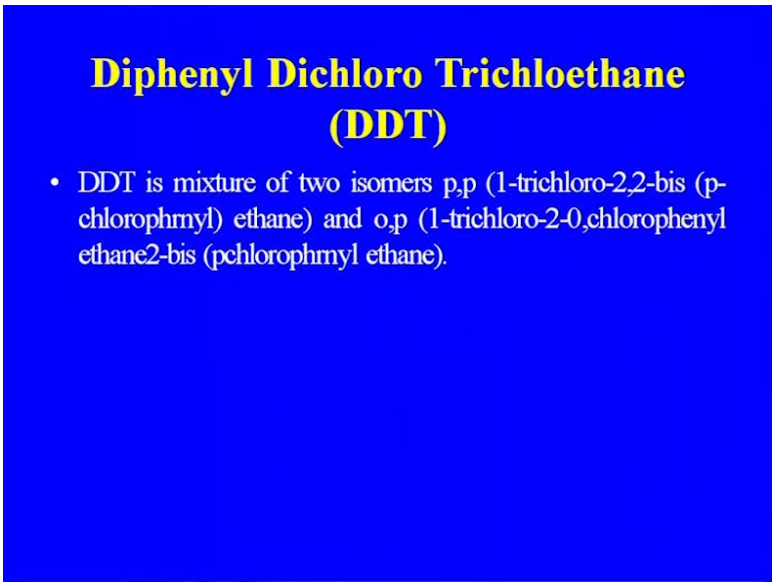

So, DDT is mixture of 2 isomers: para trichloro bis2 2-bis and ortho para, 1-trichloro-2-0, chloro-2, chlorophenyl ethane2-bis, pchlorophrnyl ethane.

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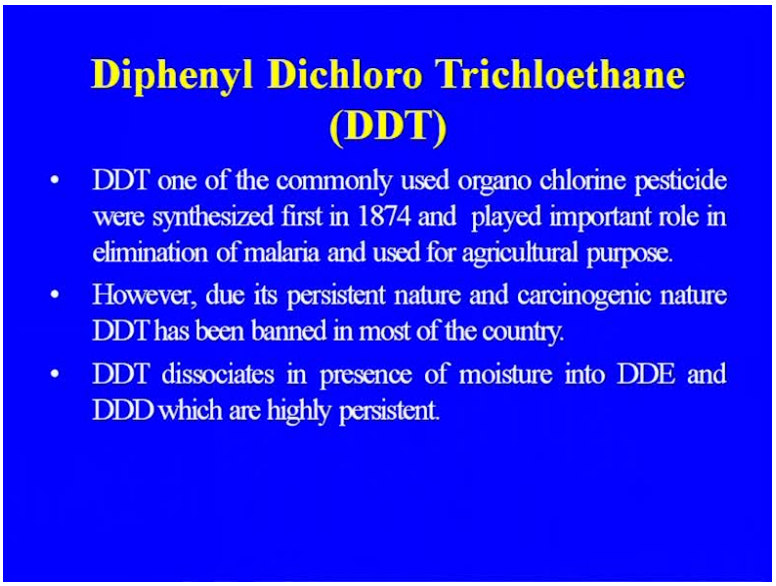

DDT is one of the commonly used organo chloride pesticide, this was first synthesized in 1874 and played important role in the elimination of the malaria. As I told you earlier that and used for the agriculture purpose. Main use started with the malaria and the elimination of the malaria disease that is because of the use of the DDT that was started during the after getting the independence.

However, due to its persistent nature and the carcinogenic nature DDT has been banned in most of the country. DDT dissociates in presence of moisture into DDE and DDD which are highly persistent in nature because they will remain in the environment for very-very long time and they will not bio. So, steps in the DDT manufacture.

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Manufacture of the mono-chlorobenzene through chlorination of benzene using the iron catalyst, manufacture of chloral through chlorination of ethyl alcohol, manufacture of DDT through condensation reaction between MCB and chloral means the MCB is the mono-chloro benzene and using oleum as the condensing agent. Recovery of the by products, dilute HCL, dichlorobenzene and sulphuric acid. So, this was the process about the DDT manufacture that is but as I told you because of the highly carcinogenic nature, one of the major constraint about all the pesticide because they are discharging lot the your hazardous material during the process manufacture, it is not only the during the use of the pesticide but also during the manufacture also, the same thing is in case of the DDT also.

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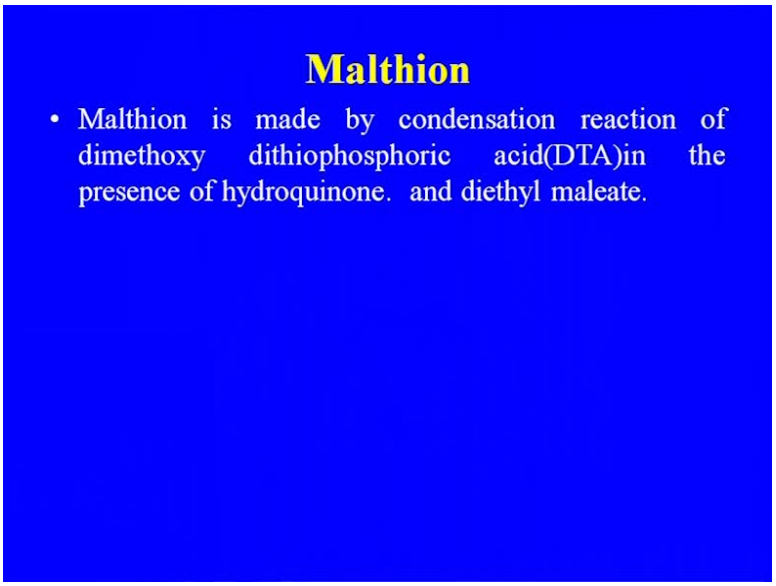

Another very important pesticide is Malthion which is made by condensation reaction of dimethoxy dithiophosphoric acid in the presence of hydroquinone and diethyl maleate.

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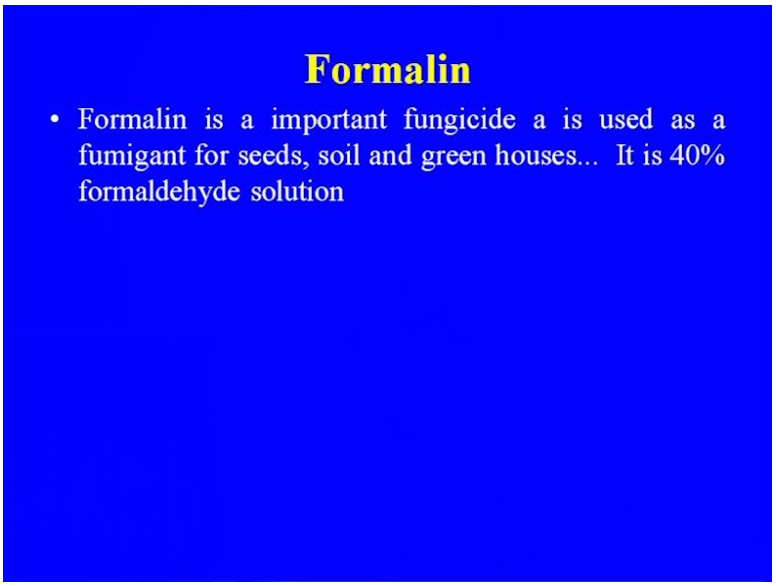

Formalin is an important fungicide and is used as a fumigant for seeds, soil and green houses. It is 40 percent formaldehyde solution because this is the one of the, another important use of the formaldehyde and manufacture of formaldehyde we discussed earlier in the petrochemical section. So, the many of the raw material basic raw material which we are taking from the petrochemical route now we are taking those raw material,

not through the coal route which was the earlier route for getting many of the organic chemicals.

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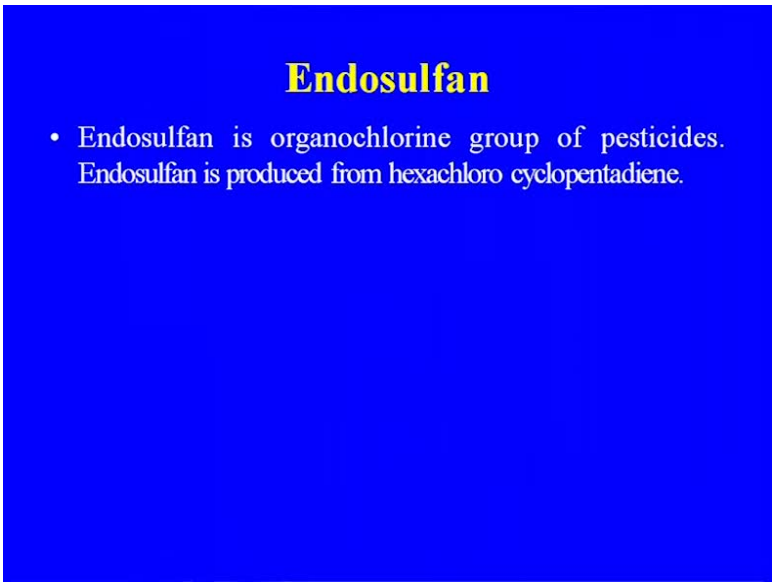

Endosulfan is a organochlorine group of the pesticide. Endosulfan is produced from hexachloro cyclropentadiene and this cyclopentadiene while discussing the C4, C5 recovery in case of the FCC gasses and the cracker gasses. Discussed the importance why the cyclopentadiene that is important to recover from the C5 gasses.

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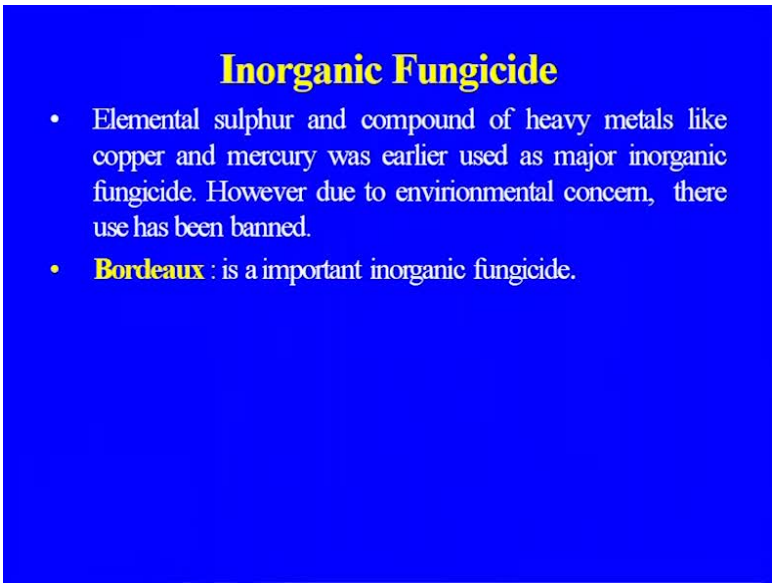

Inorganic fungicide, because we are having both organic and inorganic fungicides. Inorganic fungicide the elemental sulphur and compound of heavy materials like copper and mercury was earlier used as major inorganic fungicide. However due to environmental concern there has been banned on their use. The Bordeaux is an important inorganic fungicide.

Now, let us come to the benzene hexachloride and you see the during the manufacture of the benzene hexachloride we need lot of the chlorine and as I told you earlier that the kanoria chemical which is started making the caustic chlorine, the caustic that was being used by the aluminium plant there and the chlorine that is being used for making of the benzene hexachloride.

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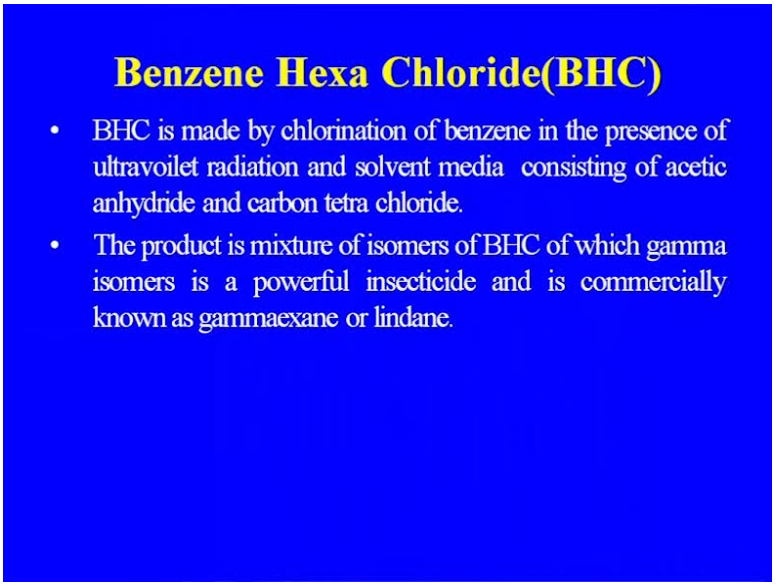

So, benzene hexachloride is made by the chlorination of benzene, again here, the basic raw material in the benzene in the presence of ultraviolet radiation and solvent media consisting of the acetic anhydride and carbon tetrachloride. The product is mixture of isomers of BHC of which gamma isomer is a powerful in insecticide and is commonly known as gammaexane or the lindane. 2, 4-D this is the very commonly, we use this term 2,4-D. So, 2,4 dichloro phenoxyl chloro acetic acid this is the name of the 2, 4-D. 2, 4-D is an important herbicide.

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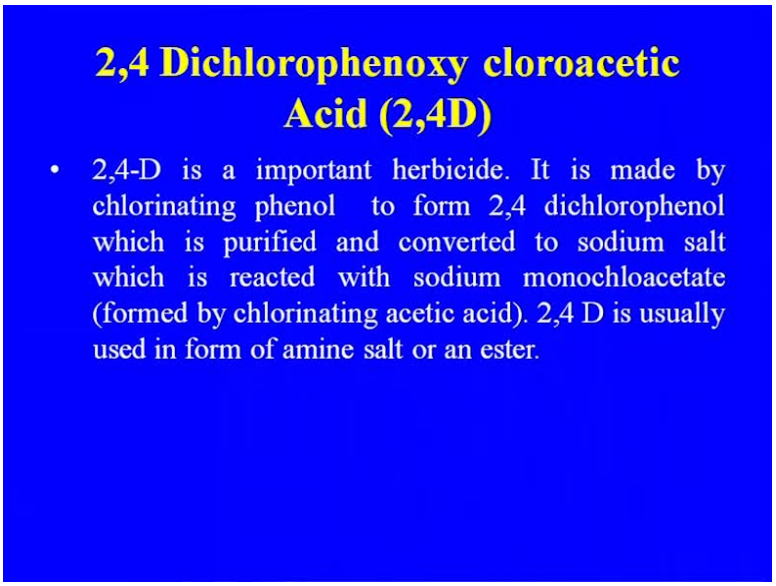

It is made by chlorinating phenol to form. Again phenol, the basic raw material that is the benzene or it may be from the cumin route. So, phenol to form 2,4 dichloro phenol which purified and converted to sodium salt, which is reacted with the sodium monochloroacetate formed by chlorinating acetic acid. 2, 4-D is usually used in form of amine salt or an ester. So, this is the how we are making the 2, 4-D ethion.

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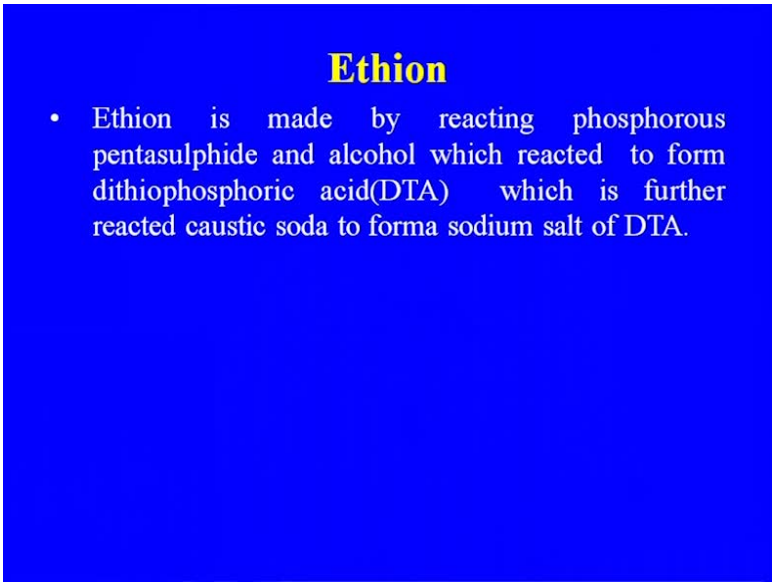

Ethion is made by reacting phosphorus pentasulphide and alcohol which is reacted to form dithiophosphoric acid (DTA), which is further reacted with caustic soda to form sodium salt of DTA.

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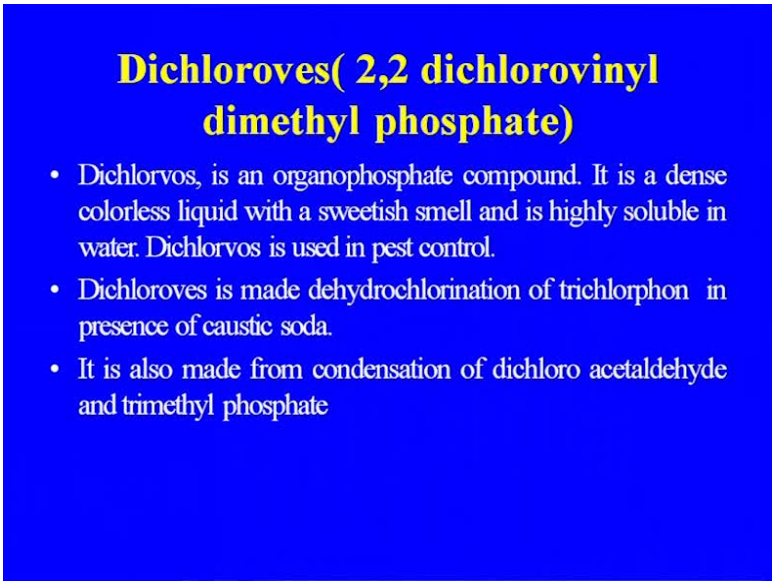

Dichlorvos so, this is 2 dichlorovinyl dimethyl phosphate. Dichlorvos is an organic organophosphate compound. It is a dense colorless liquid with a sweetish smell and is highly soluble in water. Dichlorvos is used in pest control. Dichlorvos is made by dehydrochlorination of trichlorophon in presence of caustic soda. It is also made from the condensation of the dichloro acetaldehyde and trimethyl phosphate. So, this was in brief about the some of the important pesticide and if you see the tour the raw material which is needed for the making of the pesticide that is the some of the aromatics, they are important actually and if some of the phosphates that is being used for the making of the organophosphate insecticide.

Now, actually as I told you the environmental concern, there is lot of the environmental concern are there because of use of the pesticide and now, if you see the water, ground water that has been reported contaminated by heavy materials, by the pesticides and lot of the pesticide which is being used that is we are inhaling, that is going in our body through the food grain. So, lot of the environmental concern are there and the because what we are doing in case of use of the pesticide we will have to take precaution while using, which we are not taking and so, because of them because of diet problem lot of the

environmental hazards has been reported by the use of the pesticides. And even you take the case of good knight we are continuously exposed on to the vapour by inhaling during the when we are sleeping.

So, this is the how a large number of the even other mosquito which we are using while spraying definitely, we are also exposed to that. So, these were the some of the concern about the use of the pesticide. So, again the same bio-pesticides, bio-fertilizers because of the problems of the environmental problem we have started thinking the same the composed or the neem in case of the fertilizer also. The neem that you see the one of the very important tree that is there and so that the neem fertilizer, neem pesticide, neem even you are that is you are using the tooth paste, neem soap. So, this is the how the importance. So, the let us discuss about the bio-pesticide because now the because of the environmental concern.

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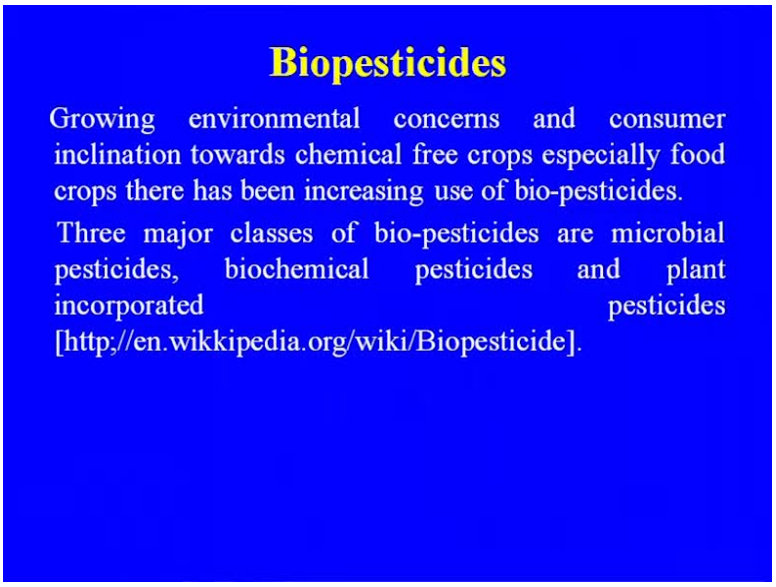

There is growing environmental concern and consumer inclination towards chemical free crops especially food crops there has been increasing use of the bio pesticides. Now, we are pesticide free food, green food. So, this is the how we are now has lead to this is, has been the major driving force the environmental concern for the again development the bio pesticide.

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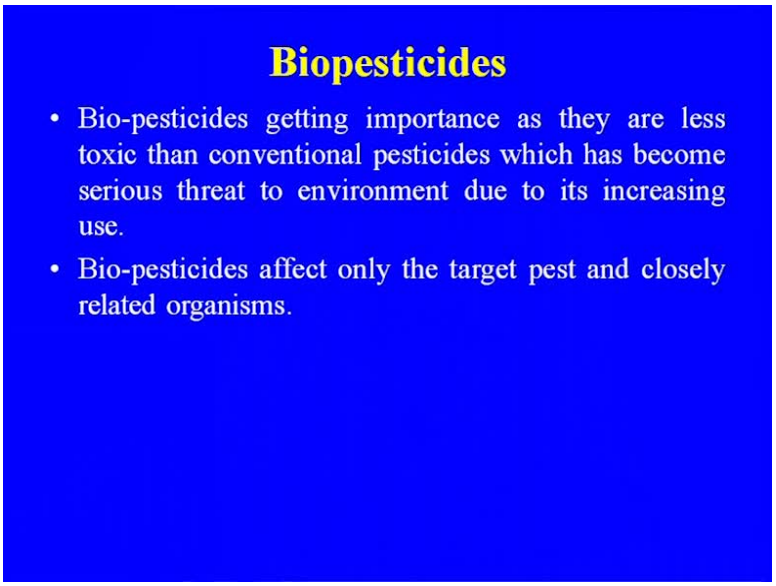

3 major classes of the bio-pesticides are microbial pesticides, biochemical pesticides and plant incorporated pesticides. Bio-pesticide getting importance as they are less toxic than the conventional pesticide which has become serious threat to the environment due to its increasing use as I told you the problem that we are facing. Bio pesticides affect only the target pest and closely related organisms, so this is because what we need, only we need the target pest should be affected in case of the other chemical pesticide other problems are also there. So, that is why we prefer the bio pesticides.

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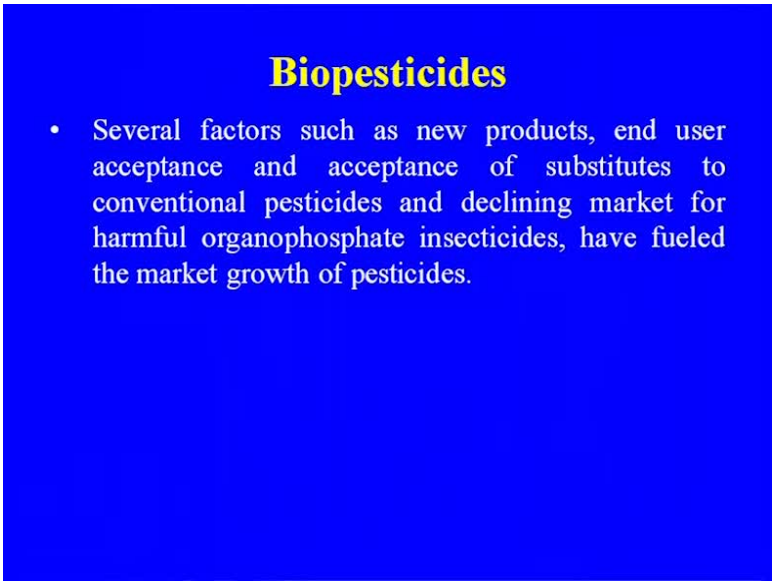

Several factors such as new products, end user acceptance and acceptance of the substitute to conventional pesticide and declining market for harmful organophosphate insecticide, have fuelled the market growth of the bio pesticide. The pesticide in general and then the driving force are coming up the more-more bio pesticide.

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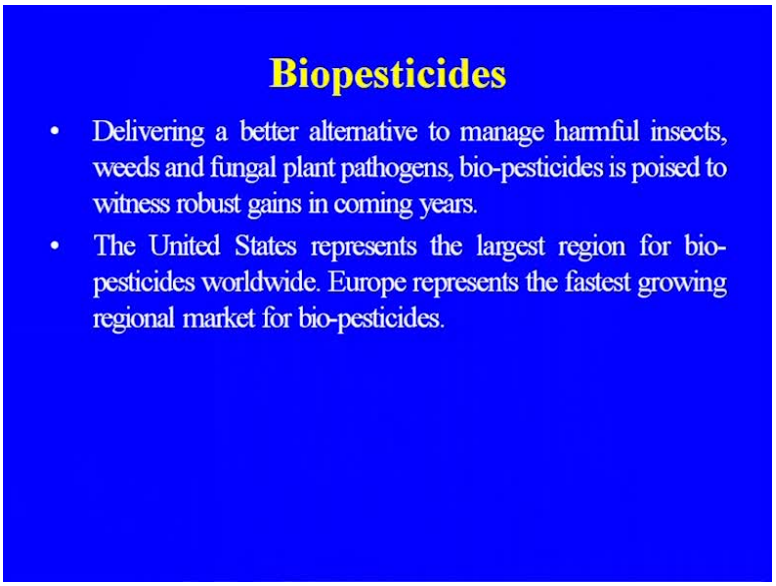

Delivering a better alternative to manage harmful insects, weeds and fungal plant, pathogens, bio pesticide is poised to witness robust gains in the coming years. The United States represents the largest reason for bio pesticide worldwide. Europe represents the fastest growing regional market for bio pesticide.

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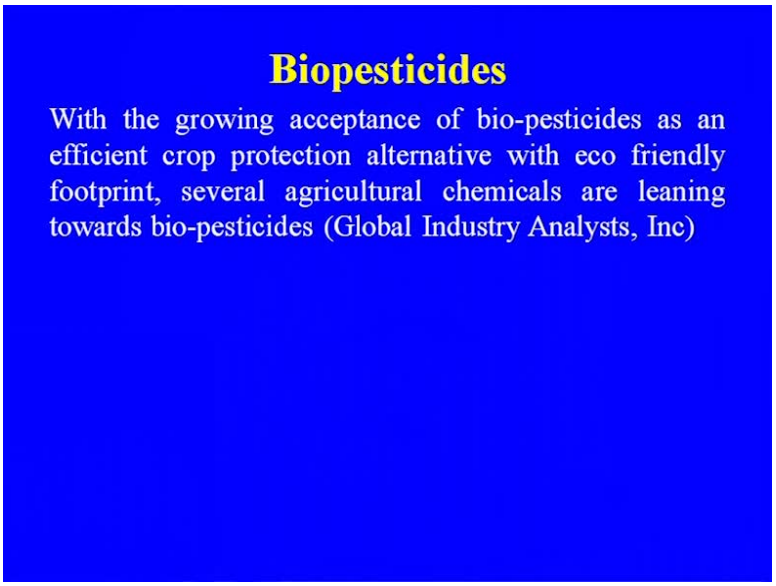

With the growing acceptance of the bio pesticides as an efficient crop protection alternative with eco friendly footprint, several agricultural chemicals are leaning towards leaning towards the bio-pesticides.

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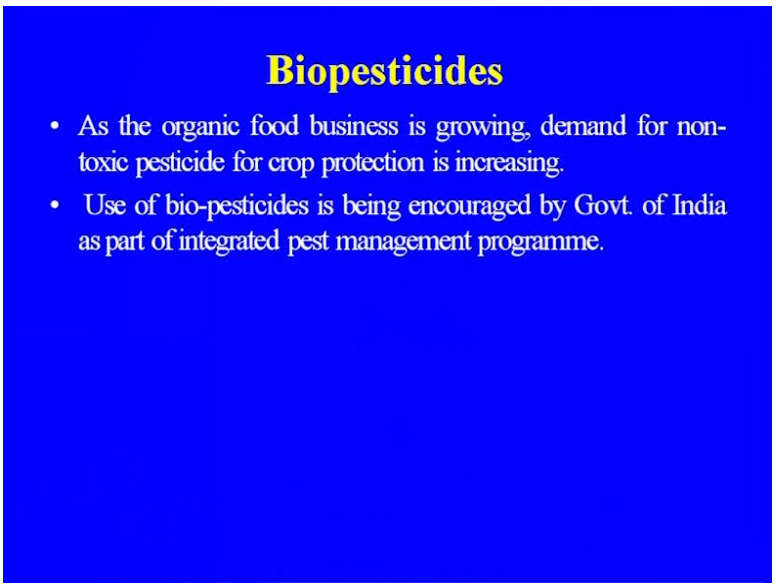

As the organic food business now, we call it the organic food. So, the organic food business is growing, demand for non toxic pesticide for crop protection is crop protection is increasing. So, now you must have seen advertisement the organic food means the now various companies are there which are marketing their products which we are using

in daily that is, as an organic food. Use of the bio pesticide is being encouraged by government of India as part of the integrated pest management program.

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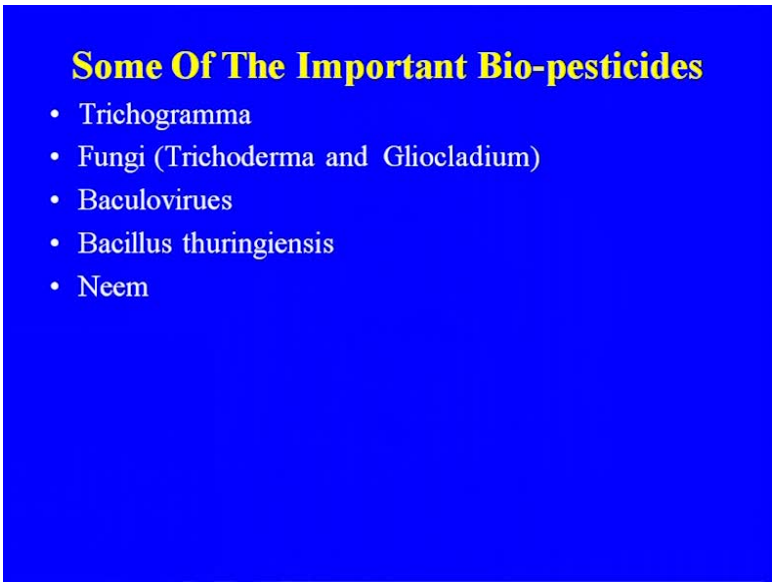

Some of the important bio pesticides: Trichogramma, fungi trichoderma and gliocladium and the baculovirues, bacillus thuringiensis, neem. Neem is the one of the actually the important bio pesticide and it is used, earlier there was less use with the coming of the more pest chemical pesticide, but again people have started thinking of the neem as the pesticide as well as in the part of the fertilizer also.

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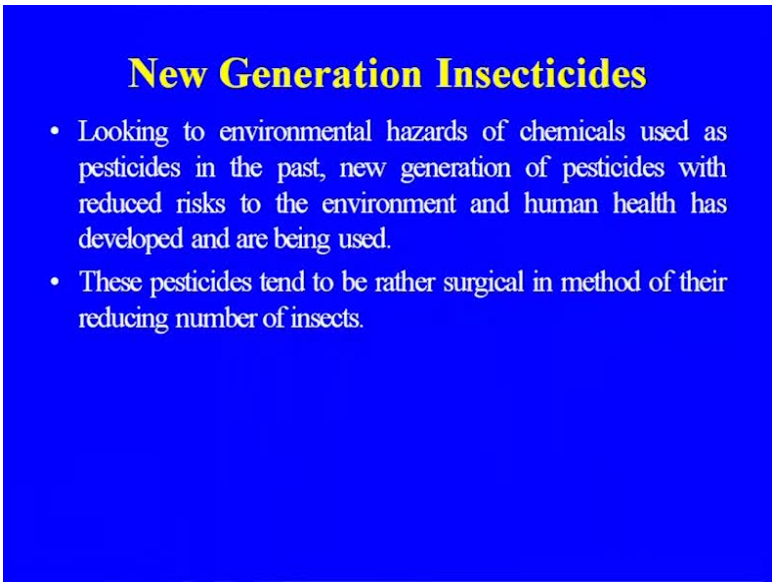

Now, we call it the new generation NGI new generation insecticide. Looking to the environmental hazards of the chemicals used as pesticide in the past, new generation of pesticides with reduced risks to the environment and human health has developed and are being used. These pesticides tend to be rather surgical in method for their reducing number of insects.

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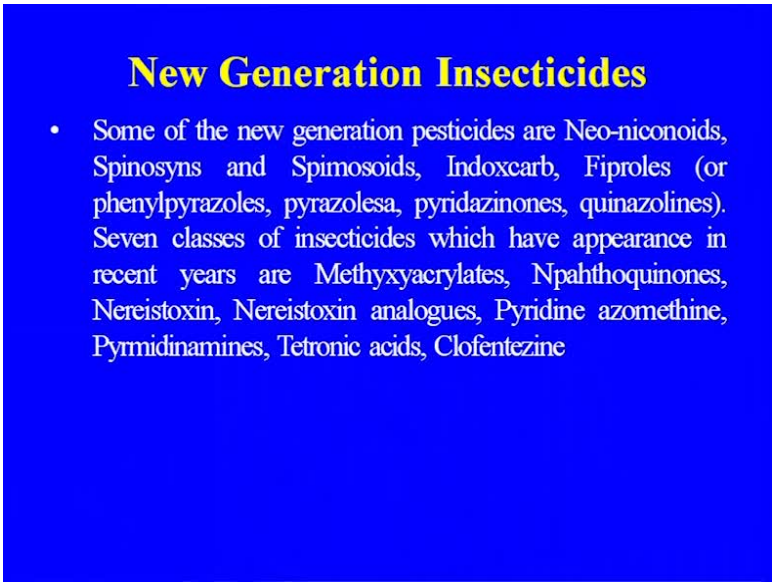

Some of the new generation pesticide are neo-niconoids and then the spinosyns and the spymosoids, indoxcarb, fiproles or the phenylpyrazoles, pyrazolesa, pyridazinones, quinazolines. 7 classes of insecticides which have appearance in the recent years are methyxyacrylates, Npahthoquinones, nereistoxin, nereistoxin analogues, pyridine azomethine, pyrmidinamines, tetronic acids, clofentazenes. While discussing the petrochemical, because you see the one of the large integrated chemical plant they are making the pyridine and prechlorine from the alcohol route, the molasses route because they are making the acetal dehyde. So, the pyridine and prechlorine that is one of the they are very valuable product that I told you that this is the your organic now, jubiliant organization it is called so, they are making the pyridine and prechlorine and the cyclopentadiene that I told you earlier that is been the by the recovery from the C 5.

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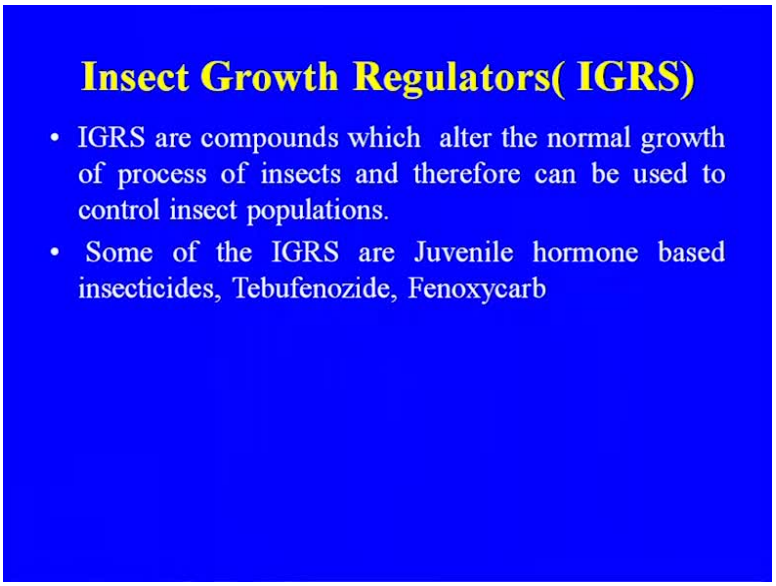

IGRS is the insect growth regulator what we call is the IGRS are compounds which alter the normal growth of the process of the insect and therefore, can be used to control insect population. Some of the IGRS are the juvenile hormone based insecticides then the tebufenozide and fenoxycarb. So, this was about the various pesticide and insecticide, different of types of the pesticide which we are making in India and the how the this has been playing important role and the various type of the actually the so far the production is concerned, different small to large integrated plants are there which are also making the basic raw material for the ingredient for the pesticide industry.

So, this is the how the importance of the pesticide is in there in our crop protection and they have played important role and the use of the insecticide or the pesticide that is increasing day by day because of the many of the insects they are breaking more repent and they are not actually responding to the various pesticide and so, the new generation of the pesticide, new type of the pesticide is being developed. Even, we must have seen that the in case of the mosquito various type of the now, it is market in the market we are using for the control.

So, this was in brief about the pesticide industry and the pesticide which have the pesticide for different purpose. In the next lecture, we will be discussing about the dyes and intermediate because that is also one of the important sector of chemical industry although, if you compare with chemical industry the total amount in is less but still that

is one of the very important, because just like here, in case of the pesticide they have been able to provide more and more food. There in case of the dyes and intermediate, they have made our life more and more colourful.