



# ENVIRONMENTAL TOXICOLOGY WITH SPECIAL REFERENCE TO PESTICIDES ON REPRODUCTIVE SYSTEM

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A Pesticide is a substances or mixture of substance intended for preventing, destroying, repelling, lessening the damage caused by the pest. They are also widespread environmental chemicals found in food, water, air and soil. Everyone's reproductive age is potentially vulnerable to pesticide related adverse health consequences. Pesticides exposure can interference with all developmental stages of reproductive function in adult males and females and have been associated with effect on menarche, infertility, menopause, male infertility like reduction of sperm motility and density. A story of suffering and tragedy in Kasaragod district with high incidence of reproductive disorder is due to pesticide endosulfan used in the cashew plantations. This paper provides guidance about how to prevent exposure to pesticides and incorporate organic farming. As the exposure has become unavoidable for our generation, this is the high time that we should take steps to reduce the use of pesticide so that we can give a healthy society to the next generation.

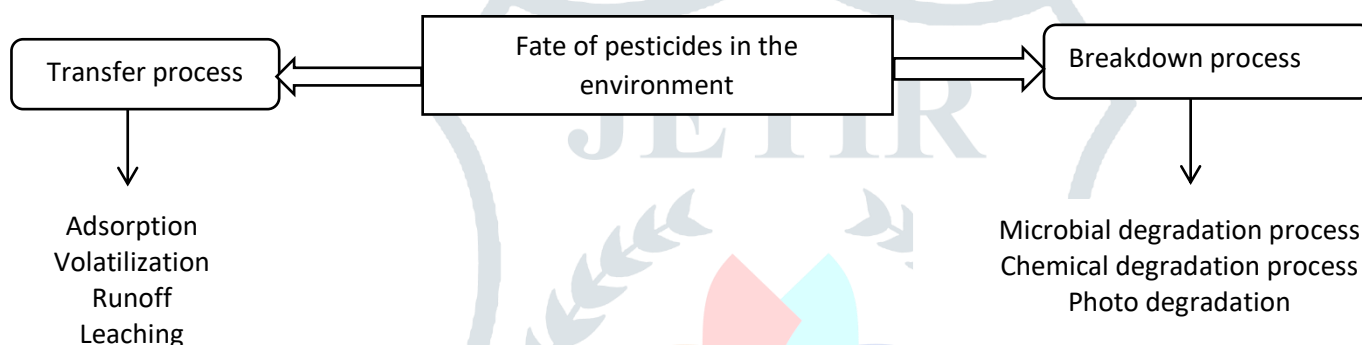
**Key words:** Environmental toxicology, Pesticide, Reproductive system, Organic farming.

**INTRODUCTION** - Environmental toxicology is a multidisciplinary field of science concerned with the study of the harmful effects of the various chemical, biological and physical agents on living organisms. Harmful effects of chemical and biological agents can include toxins from pollutants, insecticides, pesticides and fertilizers. Rachel Corson – considered as the mother of environmental toxicology

she made it a distinct field within toxicology in 1962 with the publication of her book “Silent-Spring” which covers the effects of uncontrolled pesticide use.

**PESTICIDES:** A pesticide is a substance/mixture of substance intended for preventing, destroying, repelling, and lessening the damage caused by the pest. Once a pesticide has been released into the environment it can be broken down by exposure to sunlight (photolysis) exposure to water (hydrolysis) exposure to other chemicals (oxidation and reduction).

Pesticide cycle includes Adsorption, Volatilization, Spray drift, Runoff, Leaching, Absorption, Degradation (Breakdown Process)



**Adsorption** - Adsorption is the binding of pesticides to soil particles.

**Volatilization**- Volatilization is the process of converting solids or liquids into a gas, which can move away from the initial application site.

**Spray drift** - Spray drift is the airborne movement of spray droplets away from a treatment site during application.

**Runoff** - Runoff is the movement of pesticides in water over a sloping surface.

**Leaching** - Leaching is the movement of pesticides in water through the soil.

**ABSORPTION** -Uptake of pesticides and other chemicals into plants or microorganisms.

**Degradation or Breakdown Processes**

**Microbial breakdown** - Microbial breakdown is the breakdown of chemicals by microorganisms such as fungi and bacteria.

**Chemical breakdown** - Chemical breakdown is the breakdown of pesticides by chemical reactions in the soil.

**Photo degradation or Photolysis**- Photo degradation or Photolysis is the breakdown of pesticides by sunlight. All pesticides are susceptible to photo degradation to some extent.

Hydrolysis - Water also degrades pesticides by dividing large molecules into smaller ones.

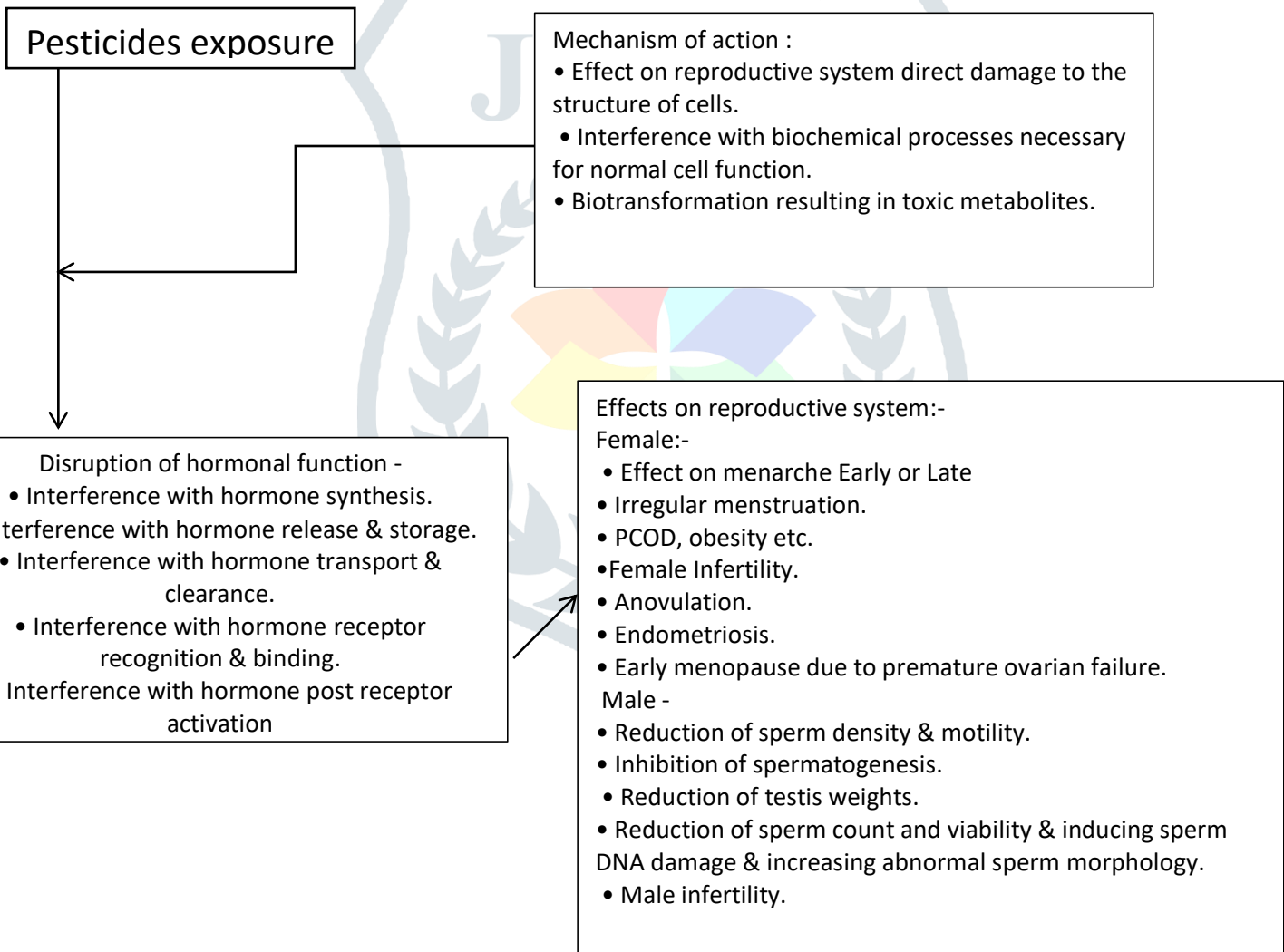
दूषितं देशकालान्निदिवास्वप्नैरभीक्षणशः ।

यस्माद्दूषयते धातून् तस्माद्दूषीविषं स्मृतम् ॥३३॥ सु.क .२/३३

A constant exposure to particular time, place and diet as well as constant & regular day sleep tends to vitiate the dhatus of the body and this poison is consequently known as dushi visha.

सथानानुसारदूषीदिलकण -If दूषी विष is localized in the रस→effects other धातु→subsequently effects the शुक्रधातु→reproductive system disorders.

Effects of pesticides exposure on reproductive system –



Endosulfan - It was sprayed in the cashew plantations in Kasargod district since 1976, till 2001 regularly three times every year. The aerial spraying was allegedly undertaken to contain the menace of the tea mosquito bug just after three years. The

ill effects of endosulfan spraying came to know as early as 1979, stunted Growth and deformed limbs were noticed among new born calves.

The ill effects of endosulfan used in the cashew plantations of Kasargod district on reproductive system -

In males, effecting Spermatogenic cells, semen quality, sperm count and morphology.

Testicular necrosis, Aspermatogenesis, Degeneration of seminiferous tubule epithelium, Puberty delayed in boys, Infertility among men.

In females, girls attain menarche early, menstrual disorders are frequent.

Endosulfan is experimentally shown to have estrogenic effects.

Organopesticides - Organopesticides (OPs) are a group of various synthetic chemicals prevalently used in agriculture and homestead plantations. OPs were originally developed to remove insects, weeds, and other pests from agricultural fields for improving crop yields. Modern pesticides including organochlorine pesticides, organophosphorus pesticides, and amido-formyl ester are closely related to our lives. Many people are exposed to various OPs during farming practice. OPs can cause adverse effects and provoke serious impacts on normal reproductive functions of humans, resulting in loss of fertility. The effects of OPs in the reproductive system include association with fluctuation in the levels of sex hormones, delayed menstrual cycle, ovarian dysfunction, alteration in ovary weight, changes of follicle growth, altered oocyte feasibility, and changed the quality of spermatogenesis. Current literature clearly states that exposure to various OPs can impair the fertility of women and cause a high risk of reproductive potential. However, investigations on OPs exposure to woman fertility remain scarce.

Pesticide effects on male reproductive system. Results indicate that semen changes are multifactorial in the workers exposed to pesticides as there are numerous factors affecting sperm quality in occupational exposures. Majority of pesticides including organo phosphorus affect the male reproductive system by mechanisms such as reduction of sperm density and motility, inhibition of spermatogenesis, reduction of testis weights, reduction of sperm counts, motility, viability and density, and inducing sperm DNA damage, and increasing abnormal sperm morphology. Reduced weight of testes, epididymis, seminal vesicle, and ventral prostate, seminiferous tubule degeneration, change in plasma levels of testosterone, follicle-stimulating hormone (FSH), and luteinizing hormone (LH), decreased level and activity of the antioxidant enzymes in testes, and inhibited testicular steroidogenesis are other possible mechanisms. Moreover, DDT and its metabolites have estrogenic

effects on males. Although effect of pesticides on sperm quality is undeniable, well-designed long-term studies are needed to elucidate all the possible affecting variables such as socioeconomic, cultural, nutritional, occupational, physical, and clinical characteristics alongside pesticides.

Pesticides such as DDT, linuron, and others, heavy metals like mercury, lead, cadmium, and copper, and substances from various industrial uses and residues such as dioxins, polychlorinated biphenyls (PCBs), ethylene dibromide (EDB), phthalates, polyvinyl chloride (PVC), and ethanol are among the main endocrine disruptors that can cause male infertility. Based on the literature, gonadal dysfunction and congenital malformation are the main alterations caused by these substances in the male reproductive system.

## Carbaryl

Carbaryl is an insecticide used on a variety of crops. Acute (short-term) and chronic (long-term) occupational human exposure to carbaryl has been observed to cause cholinesterase inhibition, and reduced levels of this enzyme in the blood caused neurological effects. Two studies at a carbaryl manufacturing factory have shown that carbaryl exposure affects the quantity and quality of sperm produced by the workers. One study found that frequent exposure of workers to this chemical induced very low sperm counts as compared to a control group of unexposed workers. This result was proved to be significant based on one statistical analysis, but has been criticized because of a second statistical test proving only a closer significance. A second study of the same sperm samples found that the number of sperm abnormalities was increased in workers who were being exposed to carbaryl.

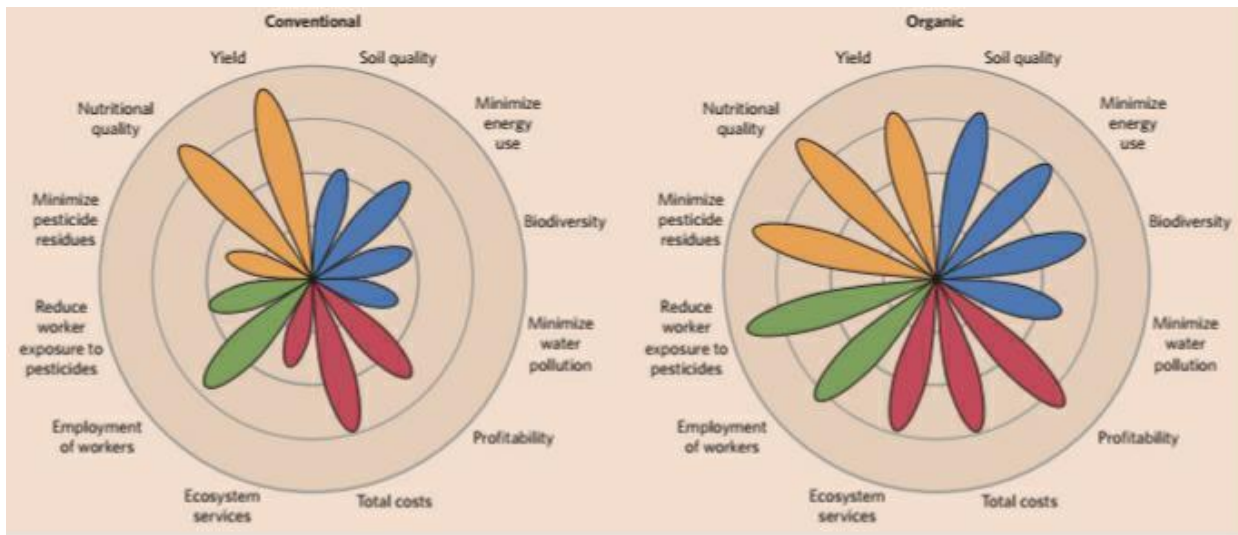
Agent	Industry or occupational group	Reported effects of female exposure	Reported effects of male exposure
Organic solvents in general	Painting, degreasing, shoemaking, printing, dry cleaning, metal industry and several other fields of industry	Reduced fertility, menstrual disorders, foetal loss, birth defects, preterm birth, neurobehavioral effects, childhood leukaemia	Delayed conception, reduced semen quality, foetal loss, birth defects
Benzene	Petrochemical industry, laboratory personnel	Foetal loss, reduced fertility, low birth weight,	
Carbon disulfide	Viscose rayon industry	Menstrual disorders	Decreased libido and potency
Some ethylene glycol ethers and their acetates	Electronics industry, silk screen printing, photography and dyeing, shipyard painting, metal casting, chemical industry, other industries	Reduced fertility, foetal loss, birth defects, menstrual disorders	Reduced semen quality
Tetrachloroethylene	Dry cleaning, degreasing	Reduced fertility, foetal loss	
Toluene	Shoe industry, painting, laboratory work	Reduced fertility, foetal loss	
Metals			
Lead	Battery industry, lead smelting, foundries, pottery industry, ammunition industry and some other metal industries	Reduced fertility, foetal loss, preterm birth, low birth weight, birth defects, impaired cognitive development	Reduced semen quality, reduced fertility, foetal loss, birth defects
Inorganic mercury	Lamp industry, chloralkali industry, dental personnel	Reduced fertility, menstrual disorders, foetal loss	Foetal loss
Pesticides <sup>a</sup>	Agriculture, gardening, greenhouse work	Reduced fertility, foetal loss, birth defects, preterm birth, reduced foetal growth, neurodevelopmental effects, childhood leukaemia	Reduced sperm quality, reduced fertility, foetal loss, birth defects, childhood cancer
Pharmaceuticals			
Anaesthetic gases	Operating rooms, delivery wards, dental offices	Foetal loss, reduced birth weight, preterm birth, birth defects, reduced fertility	
Nitrous oxide	Operating rooms, delivery wards, dental offices	Foetal loss, reduced birth weight, reduced fertility	
Antineoplastic agents	Hospital workers, pharmaceutical industry	Menstrual dysfunction, reduced fertility, foetal loss, premature birth, low birth weight, birth defects	
Carbon monoxide	Iron and steel foundries, welding, food industry, car repair, service stations	Preterm birth, intrauterine death	

<sup>a</sup> Examples of pesticides with adverse effects in men include dibromochloropropane (DBCP), 2,4-dichlorophenoxyacetic acid (2,4-D), ethylene dibromide, chlordecone, carbaryl, alachlor, atrazine and diazinon

## Discussion

To prevent the exposure to pesticide,

- By judicious usage of pesticide.
- By incorporating organic farming.
- By using natural pesticide.



Assessment of organic farming relative to conventional farming in the four major areas of sustainability. Lengths of the 12 flower petals are qualitatively based on the studies discussed in this Review and indicate the level of performance of specific sustainability metrics relative to the four circles representing 25, 50, 75 and 100%. Orange petals represent areas of production, blue petals represent areas of environmental sustainability; red petals represent areas of economic sustainability, green petals represent areas of wellbeing. The lengths of the petals illustrate that organic farming systems better balance the four areas of sustainability.

**Conclusion** – In this review, we described the different ways in which pesticides may disrupt the hormonal function of the reproductive system and in particular the ovarian cycle. Pesticides are not one common substance, but comprise a large number of distinct substances with dissimilar structures and diverse toxicity which may act through different mechanisms. Therefore, it is most likely that not just one but several of the above mentioned mechanisms are involved in the pathophysiological pathways explaining the role of pesticide exposure in ovarian cycle disturbances ultimately leading to fertility problems and other reproduction toxic effects. A disadvantage of the studies described is that they were mostly laboratory animal and cell culture studies. These often provide the first indications of potential reproductive effects of a chemical, but it is difficult to extrapolate the effects found in laboratory animals to effects that might be expected in women. Therefore, we also reviewed epidemiological studies which lead to the conclusion that exposure to pesticides may be associated with menstrual cycle disturbances, reduced fertility, prolonged time-to-pregnancy, spontaneous abortion, stillbirths, and developmental defects. However, in most of these studies specific information on pesticide exposure and the pathophysiological mechanisms involved was missing. Furthermore, we have to take into account that dose, timing, and duration

of exposure are critical to the ability of a pesticide to cause harmful effects. Nevertheless, real-life occupational exposures to pesticides appear to have adverse effects on reproduction. In future research, information on the ways in which pesticides may disrupt the hormonal function as described in this review, can be used to generate specific hypotheses for studies on the effects of pesticides on the ovarian cycle, both in toxicological and epidemiological settings. As the exposure has become unavoidable for our generation, this is the high time that we should take steps to reduce the use of pesticide so that we can give a healthy society to the next generation. Complete definitions of reproductive health should embrace everyone's right to environments that prevent exposure to potential reproductive toxicants and provide the nutritive and social sustenance necessary for healthy pregnancies, children, adults and future generations.

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