# Chapter 17
# Pesticide Analysis Techniques, Limitations, and Applications

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## ABSTRACT

*Natural or synthetic chemical compounds in pesticides are commonly used to kill pests or weeds. In general, pesticides are potentially toxic to not only organisms but also the environment and should be used safely disposed of expediently. Pesticide residues in foods may cause various crucial diseases in the body. The damage of pesticides can be changed depending on the application dose or type of active compounds. For this reason, identification and quantification of pesticides via highly selective, sensitive, accurate, and renewable techniques are of vital importance due to the large amounts of possible interfering substances during the extraction stages. Analysis of pesticide residues by analytical methods can be fluctuate based on the pesticide types. For food and health safety, maximum residue limits (MRL) of pesticides in foods were determined by the European Community. There are many analytical methods developed for identification and quantification of pesticides. Although there are some limitations, the multi-residue methods sensible for analyzing a great number of pesticides in one single run is the fastest, the most favorite, and efficient choice. However, some of the pesticides need specific methodologies and single-residue methods apply as compulsory for them. In this chapter, recent advances in the various analysis of pesticide residues in crops and their applications and limitations are discussed.*

DOI: 10.4018/978-1-5225-6111-8.ch017

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## INTRODUCTION

Pesticides are generally used for obtaining high quality and yield of agricultural crops by farmers. They can prevent agricultural crops from quality and quantity losses. Pesticides are chemicals and widely used all over the world for many years. Known as an essential nutrient for plants, sulfur was the oldest pesticide that kills insects, mites, fungi, and rodents. Until the 1940s, chemicals which were derived from plants and inorganic compounds were used for pest control (Fishel, 2009). Then chemicals including plant growth regulators and synthetic substances started to be used for plant protection. However, most of the chemicals are poisonous to the environment and living organisms. These chemicals can be classified on the basis of their use for insect killers as insecticides, weed killers as herbicides, fungi killers as fungicides, rodent killers as rodenticides, etc. (Aktar et al., 2009). Classification of pesticides are given in Table 1 (Jayaraj et al., 2016)

Applied pesticides can be absorbed by various parts of plants such as roots and leaves and also can move and translocate capability from one part to other parts of the plant. Due to having several benefits particularly protection of yield and crop reduction and improving fruit quality, pesticides are widely used for agricultural production for many years. However, pesticides are dangerous and have unwanted side

*Table 1. Classification of pesticides*

| Chemical Group | Chemical Names |
|---|---|
| Organochlorines | DDT,DDD, Dicofol, Aldrin, Dieldrin, Chlorobenziate, Lindane, BHC, Methoxychloroaldrin, Chlordane, Heptaclor, Endosufan, Isodrin, Isobenzan, Toxaphene. |
| Organophosphates | Dimefox, Mipafox, methyl parathion, Ronnel, enitrothion, Bidrin, Phorate, Fenthion, caumphos, Abate, Dichlorovas, Diptrex, Phosphomidon, Demetox, Oxydemeton-methyl, Malathion, Dimethoate, Trichlorofan |
| Carbamates | **Methyl:** Carbaryl, Carbanolate, Prupoxur, Dimethan, Dimetilan, Isolan, Carbofuran, Pyrolan, Aminocarb, Aldicarb<br>**Thio:** Vernolate, Pebulate, Diallate, Monilate, Butylate, Cycloate, Trillate, Thiourea<br>**Dithio:** Methan, Thiram, Ferban, Amoban, Naban, Zineb, Maneb, Zirampolyran, Dithane M- 45 |
| Pyrethroids | Allethrin, Bonthrin, Dimethrin, Tetramethrin, Ptrethrin, Cyclethrin, Furethrin, Fenevelerate, Alphamethrin, Decamethrin, Cypermethrin |
| Phenylamides | **Carbanilates:** Barban, Carbetamide, Chlororprofan, Prophan, Phenylurea, Fenuron, Monuron, Diuron, Flumeturon, Chloroxuron, Neburon, Bromuron.<br>**Acylanalide:** Propanil, Solan, Dicryl, Karsil, Propachlor, Alachlor, Butachlor.<br>**Toluidines:** Trifluralin, Dipropanil, Benefin, Oryzalin, Isopropanil, Nitralin.<br>**Acetamide:** Diphenamid |
| Phenoxyalkonates | 2,4-D(2,4 Dichlorophenoxyaceticacid), 2,4 5 T(2,4 5 Trichlorophenoxyaceticacid), Dichloroprop, Mecoprop, Erbin, Sesone |
| Trazines | Atrazine, Simazine, Ametryn, Atratone, Chlorazine, Cynazine, Cyprazine, Metribuzin, Propazine, Turbutryn, Simetryn |
| Benzoicacid | Dicamba, Dichlorobenil, Chloroambin, Tricamba, Neptalan, Bromoxynil |
| Phtalimides | Captan, Diflotan, Folpet |
| Dipyrids | Paraquat, Diaquat |
| Others | Pentachlorophenol, Floroacetate, Phenylmercuricacetate, Ethylmercuricphosphate, Methylmercuricchloride, Sodiumarsenate, Calciumarsenate, Leadarsenate, Cacodylicacid, Aluminiumphosphide, Zincphosphide |

Jayaraj et al., 2016.

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