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# Surface Water Contamination Studies In The Nilgiris, India

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**Abstract:**

*The insecticide contamination in the water bodies of The Nilgiris district was assessed using the surface water samples collected by dip sampling method from farm ponds/collection wells and other irrigation sources. Fifteen sample locations adjacent to farm lands were selected so as to represent the major vegetable cultivating villages of the district. The water samples were analysed for the residues of carbofuran, quinalphos and phorate, the most commonly used insecticides which are applied by in furrow method for the management of pests of vegetables. The per cent occurrence of insecticide residues observed in the samples was 60.6, 56.1, 57.6 and 52.3 for carbofuran, quinalphos, phorate and fenvalerate, respectively. The insecticide residues were detected in the range of 50 to 1200 ng/lit for carbofuran, 10 to 740 ng/lit for quinalphos, 20 to 940 ng/lit for phorate, and 56 to 627 ng/lit for fenvalerate. The 50th percentiles calculated for carbofuran, quinalphos and phorate residues were 0.153, 0.056 and 0.006 µg/g.*

## Introduction:

The Nilgiris commonly called as “Blue Mountain”, is the smallest district situated on the northwestern part of Tamil Nadu at an altitude of 2,286 M (7,620ft) and characterized by the mountainous undulating terrain. The average annual rainfall is 1778 mm and is the major irrigation source of the district, supplemented by natural springs and rainwater collection wells (farm ponds) (NARP, 1989).

Potato and crucifers, the important vegetable crops cultivated in the district, are grown in three main seasons as summer (February - March), main (April - June) and autumn (July - September). Carbofuran, quinalphos and phorate are most commonly used by in furrow application to combat the soil pests, *viz*. cutworms, whitegrubs and nematodes (Sundaram *et al.,* 1978; NARP, 1989; CPRI, 1971; Chandramohan and Nanjan, 1992).The estimated annual pesticide consumption in agricultural sector especially, soil applied granules and dust formulations was 600MT in the Nilgiris (Vijayan and Muralidharan, 1996).

. Most of the soil applied insecticides pollute groundwater by runoff and leaching and the severity depends on land characters like slope and texture, climatic factor like rainfall intensity and physico-chemical properties of pesticides (Flury *et al.,* 1995).They find their way into various water bodies and ultimately to groundwater or remain bound to soil and undergo various degradation processes. Considering the intensive cultivation practices and pesticide use on the dynamic hilly terrain, the present study was undertaken to assess the contamination of pesticides in water sources in the vicinity of cropping locations.

## Materials and Methods:

The surface water samples were collected by dip sampling method from farm ponds/collection wells and the irrigation sources adjacent to farm lands during cropping period. Fifteen locations were selected representing the major vegetable cultivating villages of the district (Fig.1).The samples were collected using clean, amber coloured solvent bottles of 2.5 lit. capacity and were analysed for carbofuran, quinalphos, phorate and fenvalerate residues.

### Extraction

Each portion of five hundred ml of water was extracted thrice with 50 ml of saturated sodium chloride solution and dichloromethane (50, 25 and 25ml). The pooled organic layer was dried over 50g of anhydrous sodium sulphate to remove traces of moisture and the residues were dissolved in hexane (Fraction I) for final determination of carbofuran, quinalphos and phorate. The carbofuran residues were further subjected to derivatisation and then estimated (Cook *et al.,* 1977).The same aqueous portion of sample was subjected to re-extraction with n-hexane (Fraction II) for determination of fenvalerate residues.


**Fig.1 The Nilgiris district map showing the sampling locations**

| | | |
|---|---|---|
| **1.Kakkuchi** | **6.Akuni Bickatty** | **11.Kodapmandhu** |
| **2.Bickatty** | **7.Vijayanagaram Farm** | **12.K.Pallada** |
| **3.M.Pallada** | **8.Nanjanad** | **13.Thummanatty** |
| **4.Ithalar** | **9.Thalaiattimandhu** | **14.Kotagiri** |
| **5.Kappachi** | **10.Wood House Farm** | **15.Gudalur** |

**Results:**

Of the total 71 water samples analysed, forty two were contaminated with detectable level of carbofuran and was thirty seven and thirty eight in case of quinalphos and phorate, respectively. The per cent occurrence of residues in water was 60.6 for carbofuran, 56.1 for quinalphos, 57.6 for phorate and 52.3 for fenvalerate.

The maximum level of carbofuran residue detected was 1200 ng/lit and the minimum level reported was 50 ng/lit. in a sample collected from Gudalur where tea is the major crop. The high level of residues detected was 740 ng/lit. , 940 ng/lit. and 627 ng/lit. for quinalphos, phorate and fenvalerate. The highest mean value of 654.6 ng/lit. of carbofuran residue was observed in Ithalar village and the respective values for quinalphos, phorate and fenvalerate were 203.6, 231.6 and 290.0 ng/lit. (Table 1).

**Discussion:**

The irrigation water sample analysis in the present study revealed the presence of carbofuran, phorate, quinalphos and fenvalerate residues at varying levels. In the monitoring studies conducted on surface water samples and pond water samples elsewhere also revealed the presence of soil applied insecticides as contaminants due to

extensive and regular application of soil applied insecticides and location of sampling sources in and around agricultural area (Awasthi *et al.,* 2002; Dixit and Banerji, 1994).

Carbofuran was found in natural water sources located in major agricultural tracts particularly potato or other vegetable farms (Picco *et al.,* 1994: Bushway *et al.,* 1992:.Mwanthi 1998) along with detectable level of DDT, its isomers and carbaryl. In addition to carbamates, the less persistent organophosphorous insecticides like quinalphos, phorate and triazophos were reported in river water samples, where intensive pesticide use was observed (Medina *et al*., 1996: Awasthi *et al.,* 2002).

The earlier monitoring studies conducted in Udagamandalam lake water and reservoirs revealed contamination of DDT, HCH and carbofuran the most commonly used insecticides in annual crop management while isomers of DDT, HCH and endosulfan were detected in other matrices like birds, eggs and fish (Rao *et al.,* 1994: Rajukannu *et al.,* 1990: Regupathy and Kuttalam, 1992: Vijayan and Muralidharan, 1996).

In all the cases illegal use of pesticides, runoff and leaching during wet season and geographical locations of sampling sites were attributed as the sources of water body contamination. Leaching from soil to water sources depends on the solubility criteria of insecticides. The order of solubility (mg/lit) is carbofuran (351.0) > phorate (50.0) > quinalphos (17.8) > fenvalerate (<0.01) (Tomlin, 2000). This might be one of the reasons for excessive contamination with carbofuran and less with other compounds. Increased solubility of insecticides as in case of carbofuran permits natural surface waters to become repository for excessive amounts of the insecticide escaping treated areas or being accidental introduced into aquatic environment.

Though high level insecticide residues are expected to reach water bodies from point and non point sources, the actual situation prevailing is different in the study area. Carbofuran, quinalphos, phorate and fenvalerate residues were detected in 60.0 per cent of the samples and or less than that. The remaining samples showed no detectable residues. In natural field condition also pH of water, microbial load, sediments, minerals, volatilisation and photolytic factors play role in environmental decomposition of insecticides and possibly dilution effect (Trotter *et al.,* 1991; Wei *et al.,* 2000).

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**Table 1**

***Level of insecticide residues in water samples of The Nilgiris***

| S. No. | Place | Mean residues (ng/lit.) | | | |
|---|---|---|---|---|---|
| | | Carbofuran | Quinalphos | Phorate | Fenvalerate |
| 1. | Kakkuchi | 307.8 | 203.6 | 55.0 | 102.00 |
| 2. | Kappachi | 68.6 | 92.2 | 48.2 | 56.00 |
| 3. | Bickatty | 77.8 | 117.6 | 59.0 | 8.67 |
| 4. | M. Pallada | 338.8 | 88.8 | 146.2 | 209.00 |
| 5. | Ithalar | 654.6 | 107.8 | 161.8 | 199.00 |
| 6. | Akuni Bickatty | 260.4 | 86.6 | 61.6 | 27.33 |
| 7. | Vijayanagaram farm | 489.5 | 56.0 | 45.0 | **BDL** |
| 8. | Nanjanad | 546.6 | 106.2 | 125.0 | 290.00 |
| 9. | Thalaiattimandhu | 334.6 | 74.4 | 34.4 | 158.00 |
| 10. | Wood house farm | 148.5 | 68.0 | 98.5 | 32.00 |
| 11. | Kodapmandhu | 212.4 | 52.8 | 231.6 | 139.33 |
| 12. | K. Pallada | 137.6 | 79.2 | 52.0 | 200.00 |
| 13. | Thummanatty | 386.6 | 46.4 | 135.2 | 170.33 |
| 14. | Kotagiri | 53.0 | 146.4 | 73.2 | 158.33 |
| 15. | Gudalur | 34.0 | BDL | BDL | 50.33 |
| | **Range (ng/lit.)** | 50-1200 | 10-740 | 20-940 | 26-627 |
| | **Percent occurrence** | 60.6 | 56.1 | 57.6 | 52.3 |