STUDY OF GROUND AND SURFACE WATER POLLUTION WITH CHLORPYRIFOS

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Introduction

Among the agricultural insecticides, chlorpyrifos (O, O-diethyl O-3, 5, 6-trichloro-2pyridylphosphorothionate), an organophosphorus insecticide, is one of the most widely used pesticides in vegetable cultivation in Sri Lanka. Menike et al. (2007, 2008) reported that the ground water at the wells in a major agricultural field in Marassana, Kandy and the surface water along the Kiwullinda Oya stream passing by the area of study were contaminated with chlorpyrifos. This present study is carried out to investigate the possible existence of a relationship among chlorpyrifos concentration in surface and ground waters in the area, the chlorpyrifos application pattern, and rainfall.

Methodology

Water sampling was carried out at two community wells (W1 and W2), situated in the area of study and at two locations (L1 and L2) along the Kiwullinda Oya stream, the locations are selected based on the non availability of fresh water inlet sources in between the two locations. Given in Figure 1 is an area map, with marked sampling points, which was drawn according to the data, collected from the farmers on the land use and cultivation. Water samples were collected every three days during the vegetable cultivation period from 01st May to 15th August 2009. Rainfall data were collected in-situ using a rain gauge. All the water samples were collected in 500 ml amber glass bottles with glass lids, and they were transported to the Analytical Laboratory of the department within 4 hours of the sample collection. Water samples were analyzed for the presence of chlorpyrifos using a High Performance Liquid Chromatograph (HPLC) method (CIPAC 1 C, 1985). This procedure was reported in detail in Menike et al. (2007). Atmospheric and wet bulb temperatures and stream water flow rate were also measured.

Results and Discussion

Figures 2 and 3 give the sampled chlorpyrifos concentrations at the wells W1 and W2 and at the locations L1 and L2, respectively, along with chlorpyrifos application and rainfall data in the study area.

Chlorpyrifos concentration varied from 0 to 7.1 µg/l at W1, and from 0.01 to 3.25 µg/l at W2. Figure 2 reveals that there exists a somewhat strong relationship between the pesticide application peaks and the concentration peaks at the wells, when a time lag of 1 to 2 weeks are allowed for the pesticide concentrations to peak at the wells, which could be explained by the time taken for the underground movement of the pesticide from the application site to the sampling site. The highest chlorpyrifos peaks at both the wells were recorded on 18th June, which was following the chlorpyrifos spraying to snake guard plantation at approximately 2 m distance from the well on the same day with high currents of winds. The effect of rainfall appears to have no appreciable influence on chlorpyrifos concentration in the wells.

Figure 3 shows variation of chlorpyrifos concentration in Locations L1 and L2, with respect to precipitation and chlorpyrifos application to the catchments

area between location L1 and L2. The location L1 received its water from channel upstream as well as irrigation channel which runs through the cultivation fields that would brings higher quantities of chlorpyrifos residues in to the Kiwullinda Oya. L2 is situated 0.5 km away from L1 and mainly received its water from the main stream. In majority of sampling days, the chlorpyrifos concentration at L2 was lower than L1. This is due to high level contamination of side stream which brings water to Location L1. When water travels along the channel evaporation and degradation may lead to a lesser concentration at location L2. Sudden increases at L2 occurred on 2nd June are because of opening of few runoff streams directly to the Oya between L1 and L2 by farmers.

According to the Figure 3 it is clearly seen that after a high rainfall, chlorpyrifos concentration at both locations increased. However for precipitation after short drought as observed between 26th to 28th June such increase in chlorpyrifos concentration was not seen. This is attributed to the low ground water rate and percolation of water rather than runoff to the water stream.

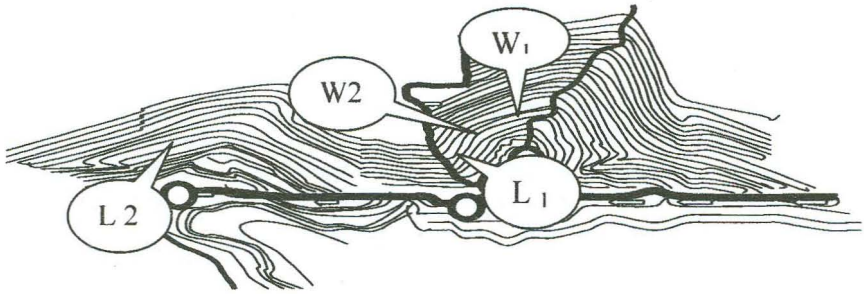

Figure 1.Sketched map of the study area

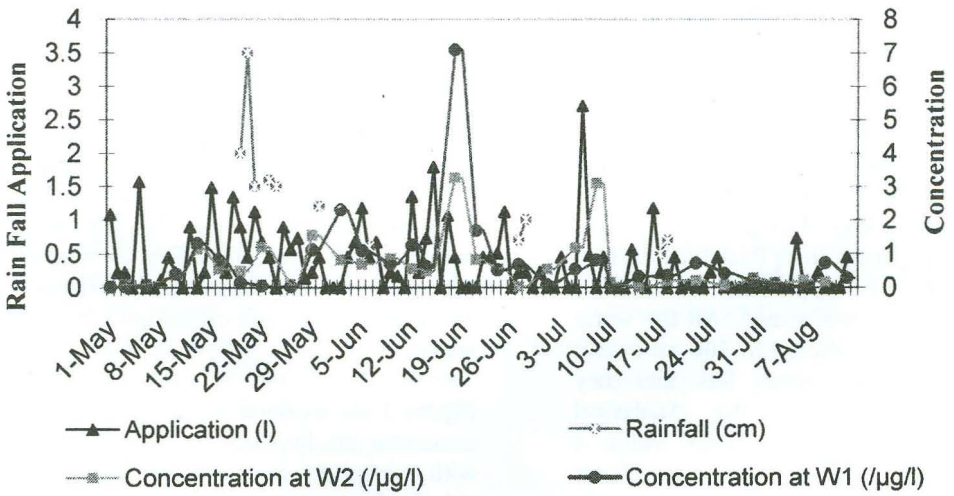

Figure 2. Chlorpyrifos concentrations at the well W1 and W2 and total chlorpyrifos application and rainfall at the area during May to August 2009

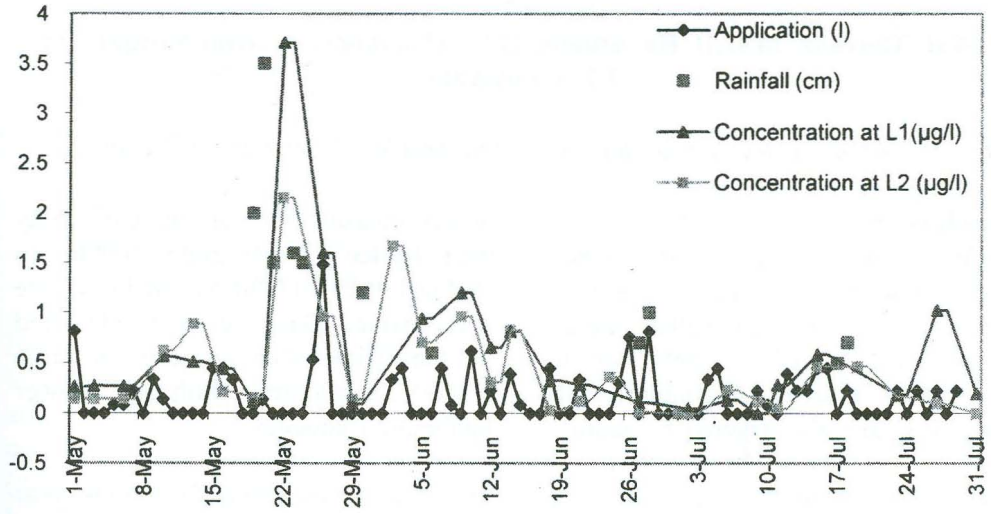

Figure 3. Chlorpyrifos concentrations at the location L1 and L2 along the stream and total chlorpyrifos application and rainfall at the area during May to August 2009

Conclusion

When there is little or no rain fall, part of chlorpyrifos contaminated on soil seem to be transported through soil up to 2 m depth to reach the ground water there by polluting the well water. Generally, when there is high rainfall chlorpyrifos concentration in well water is reduced due to the dilution effect. However pesticides application at the site near by, could diffuse through air and contaminate the well water.

When there is rainfall to the site, chlorpyrifos contaminant in the plant and on top soil from the open surface is washed off to the surface water stream and results increase the chlorpyrifos concentration in the stream. If there is no rainfall, chlorpyrifos applied to the catchments is percolated or adsorbed and is not release to the stream.

Acknowledgement

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