

Successful application of Vetiver in the reduction of pesticide concentrations in agricultural waters in Mérida Venezuela

The State of Mérida is part of the Andean mountain range of Venezuela. One of its main economic activities is agricultural production. The water that circulates through the rivers and soils flow into a main river called Mucujún, which supplies the State's drinking water system.

Previous research had indicated the presence of pesticides in these waters, motivating this research into the impact of living Vetiver barriers on the concentration levels of pesticides in the runoff from a farm that ultimately fed into the river.

The study involved the analysis of water samples, taken prior to the installation of the Vetiver barrier and on the day of completion of the planting of the Vetiver barriers, to be used as the reference sample, then following a 30 days establishment period, sampling between the dates of 11 August 2023 and 10 November 2023, to evaluate the changes in pesticide concentrations over time.

Baseline Analysis

A farm in close proximity to a tributary of the Mucujún River in the state of Mérida was selected based on its agricultural activity and use of agrochemicals of interest. Water samples were obtained from a stream feeding into the Mucujún River, that passed through the farm (Photo 1) and analyzed weekly, over a five-week period, prior to the planting of the Vetiver hedgerows. The samples were analyzed for the presence of organophosphates (POF), carbamates (PC), and organochlorine pesticides (POC).

The determination of the concentration of organophosphate and carbamate pesticides was carried out by the Ellman method, and the analysis of organochlorines was carried out by gas chromatography, utilizing an electronic capture detector on the surface waters of a stream flowing into Mucujún River and at a household sampling point in the city of Merida.

The results indicated that the surface waters passing through the land under study contained organophosphate and carbamate pesticides in total concentrations ranging between 0.131 and 0.556 ppm.

According to Venezuelan Legislation, the total concentration limits of organophosphate and carbamate pesticides in water for human consumption is 0.100 mg/l. According to this criterion, the waters of the tributary stream of the Mucujún River experience levels of contamination that make them unfit for human consumption.

In respect of the organochlorine pesticides, the analyses showed that methoxychlor, delta HCH and p,p'-DDT were the most commonly occurring in the water samples. The concentration in which they were detected, however, was not statistically different from, or above, the maximum allowable for human consumption. Current national regulations – Decrees 883 and 36.395 – establish 200µg/l as the limit for human consumption, and the data from this study did not show contamination levels that exceeded this.

Establishing Vetiver living barriers

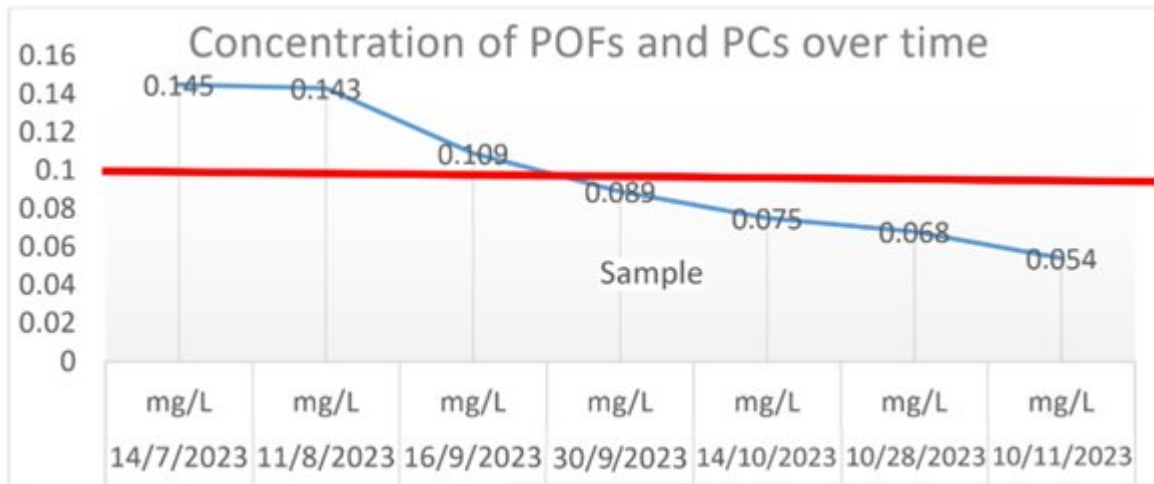
Between July 10 and July 14, 2023, Vetiver was planted to form living barriers on both sides of, and close to, the stream running through the study site. A four-week establishment period was allowed prior to the initiation of the water sampling; with the sampling occurring at the same locations that had been used to establish the baseline.

Analysis after planting Vetiver

For purposes of the analysis, a total of 7 samples were taken, beginning on 14 July 2023 (Sample 12), the day that the planting of the Vetiver was completed. The 14 July sample was used as the reference value for assessing the Vetiver barrier's capacity for taking up POFs, PCs, and POCs. The subsequent 6 samples were taken at periodic intervals between 11 August 2023 (four weeks after completion of planting) and 10 November 2023 (seventeen weeks after completion of planting). The results are shown in Graphs 1 and 2.

Graph 1 shows a continual decrease in the concentrations of the POFs and PCs in the surface water over the week sampling period. From this, it can be inferred that the Vetiver barriers caused a significant reduction in the concentrations of the POFs and PCs.

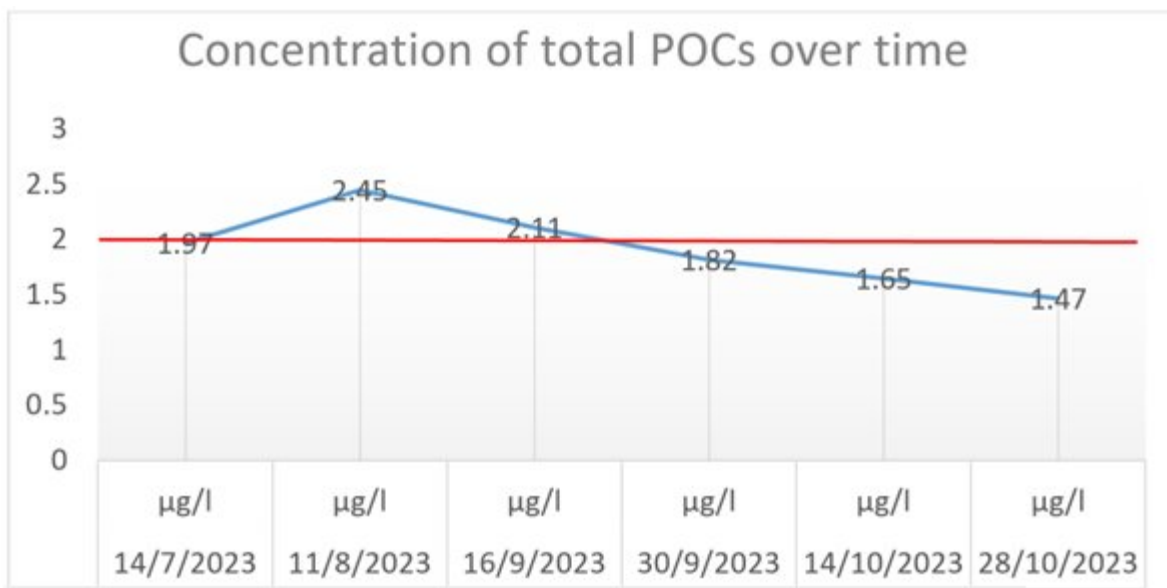
Graph 1. Decrease in the total concentration of POFs and PCs over time.



— Limit value allowed according to Venezuelan Legislation for organophosphate pesticides and total carbamates 0.100 mg/L

Graph 2. shows the continual decrease in the concentration of total organochlorine pesticides (POCs) in the weeks following establishment of the Vetiver barriers. These values are below the maximum value allowed in current national regulations (200 µg/l), which suggests that the waters of the tributary stream of the Mucujún River are not contaminated beyond the limits allowed for human consumption by POC's.

Graph No. 2. Decrease in the total concentration of POCs over time.



Limit value allowed according to Venezuelan Legislation for total organochlorine pesticides of 200 µg/l (0.200 mg/L)

Conclusion

In this study, Vetiver barriers reduced pesticide concentrations in surface water to levels lower than those considered by Venezuelan legislation to be prohibitive for human consumption. When planted in agricultural soils, the Vetiver barriers progressively reduced the concentration levels of organophosphate, carbamate, and organochlorine pesticides and so improved water quality.

Actions

1. Vetiver nurseries are being created in strategic points in the state of Mérida.
2. Explanatory content on the use of vetiver for environmental protection has been developed. Workshops and seminars are being held, and discussions on the topic will be held with students and farmers in different areas of the Páramo Merideño.

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